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PRECAMBRIAN GEOLOGY OF THE DOUBLE MER-LAKE MELVILLE REGION, LABRADOR

PHILIPPE ERDMER

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GEOLOGY OF THE DOUBLE MER-LAKE MELVILLE AREA, LABRADOR

Abstract

Mapping at 1:100 000 scale of the northeastern Grenville Province revealed the presence of the following major rock units: two polydeformed gneiss terranes of overall granitic and granodioritic composition respectively underlie more than 75% of the area; they include bodies of amphibolite and mafic dioritic gneiss as well as small amounts of aluminosilicate-bearing rocks. Both gneiss terranes are crosscut by separate suites of granite, quartz monzonite and anorthosite plutons. Post-orogenic conglomerate derived from the surrounding rocks occupies a large area near the centre of the region.

Major structures include large folds of distinct character in each gneiss terrane, a southeast-dipping thrust fault marked by a wide mylonite zone separating the gneiss terranes, and a post-orogenic graben centred on Lake Melville. Metamorphic minerals define upper amphibolite and granulite facies assemblages. Uranium mineralization at three localities in the granitic gneiss terrane is concentrated in pegmatite or diatexite of widespread regional occurrence.

The gneiss terranes appear to be polyorogenic, Paleohelikian or older tectonostratigraphic assemblages intruded by major plutons between about 1680 and 1400 Ma. Most of the geological infrastructure appears to have been in place before the Grenvillian Orogeny, which was a dominantly thermal event either with less development of ductile strain than during earlier events or with strongly inhomogeneous strain. Northwesterly thrusting along large ductile shear zones assembled the gneiss terranes into their present configuration. Post-Grenvillian northwesterly extension caused the development of the Lake Melville graben in which strata of coarse detrital rocks reach thicknesses of several kilometres.

Résumé

Un levé géologique au 1/100 000 dans la partie nord-est de la province de Grenville a établi la présence des types de roches suivants: deux terrains gneissiques polydéformés, constitués respectivement de roches granitiques et granodioritiques, occupent plus de 75% de la région levée; ces terrains comprennent des amphibolites et des gneiss dioritiques mafiques, ainsi que de faibles volumes de roches à alumino-silicates. Ces terrains gneissiques sont recoupés par des séries distinctes de granite, de monzonite quartzique, et d'anorthosite. Des conglomérats post-orogéniques dérivant des roches avoisinantes occupent une large étendue près du centre de la région.

Les structures principales comprennent des plis de grande amplitude et de caractère distinct dans chacun des terrains gneissiques, une faille de charriage à pendage sud-est, soulignée par une épaisse mylonite séparant les terrains, et un graben post-orogénique centré sur le lac Melville. Les minéraux métamorphiques sont caractéristiques des faciès amphibolite supérieur et granulite. Trois venues d'uranium dans le terrain gneissique granitique sont concentrées dans des filons de pegmatite ou de diatexite répartis dans toute la région.

Les terrains gneissiques sont considérés comme étant des assemblages tectonostratigraphiques polyorogéniques, paléohélikiens ou plus anciens, injectés de forts volumes de roches plutoniques entre 1680 et 1400 Ma environ. En général, l'infrastructure géologique semble avoir été formée avant l'événement de Grenville, qui fut surtout thermique et accompagné d'une déformation ductile, soit moindre qu'au cours de phases antérieures, soit très hétérogène. Des charriages nord-ouest le long de grandes zones de cisaillement ductile ont produit la disposition actuelle des terrains. Une extension sud-ouest post-grenvillienne est à l'origine du graben du lac Melville, dont les couches détritiques sont puissantes de plusieurs kilomètres.

INTRODUCTION

As part of the Canada-Newfoundland co-operative mineral program 1982-84, the geology of part of the Grenville Province of eastern Labrador north of Lake Melville was mapped by the author, under contract to the Geological Survey of Canada, for publication at 1:100 000 scale. This investigation was intended to provide a link between mapping by the Newfoundland Mineral Development Division to the east and west, and to delineate recently discovered uranium-bearing units.

As a result of the study, Precambrian rocks have been subdivided into 25 units, and their relationships to similar units in surrounding areas have been outlined. The continuity of major structures and of metamorphic grade with those in adjacent regions has been established; of particular relevance to the regional history is the superposed ductile and brittle strain displayed in the rocks northwest of the Lake Melville graben, and its interpretation as a record of thrust faulting followed by normal faulting.

This report presents (1) a geological map of the region (Fig. 1, in pocket); (2) a subdivision of the rock types and a description of the presumed stratigraphic relations, age and correlation of each unit; (3) an outline of structure; (4) a description of the metamorphism; (5) a review of economic geology; and, (6) an interpretation of the evolution of the area.

Location, access, and field work.

The study area is 50 to 100 km northeast of Goose Bay and covers approximately 4500 km² in six 1:50 000 scale map areas: 13F/16, 13G/11, 13G/12, 13G/13, 13G/14, and part of 13J/3 (Fig. 2). Although the study area contains neither settlements nor roads, it lies astride the Lake Melville-Hamilton Inlet waterway, the main shipping route between central and coastal Labrador. This makes most of the region readily accessible by water from Goose Bay, along Lake Melville and along Double Mer, two northeast-trending brackish water lakes that reach inland over 200 km and 100 km, respectively, from the Labrador Sea (Fig. 2).

The coastal geology was investigated by using small open boats; inland traverses were run from the shore. However, because of frequent and variable strong winds and boulder barriers and mud flats in the intertidal zone, it was often difficult to put a small boat or a float plane into shore and the most practical and reliable means of access was by helicopter. Base camps were established in June 1982 at Charley Point (a landmark on the north shore of Lake Melville, Fig. 1) and from July to September 1982 at North West River (a community of less than 1000 people, Fig. 2); the field party comprised five geologists and two aircrew.

The area on the south shore of Lake Melville was examined only briefly, and most of the information given here is taken from recently published and unpublished work by R. F. Emslie.

Geological setting.

The region lies near the eastern extremity of the Grenville Province in Canada, approximately 100 km to the south of its northern boundary, the Grenville Front, as defined in eastern Labrador by Gower *et al.* (1980). Rocks of the region are part of an east-trending belt of dominantly tonalite and granodiorite gneiss with supracrustal remnants that occupies most of eastern Labrador. On the basis of structural, metamorphic and lithologic contrasts, this belt comprises two distinct, fault-bounded terranes (Gower, 1984). The Groswater Bay terrane, to the north, consists of a variety of orthogneiss and paragneiss; it includes rocks of the Trans-Labrador batholith (Wardle *et al.*, 1982), a composite granitic body in which individual plutons have yielded ages from 1650-1700 Ma to 1350-1400 Ma. The Lake Melville terrane, to the south, which also consists of metaplutonic and high grade metasedimentary rocks, is largely undated. It is intruded by the Mealy Mountains anorthosite complex to the south, which has yielded an age of 1640 Ma (Emslie, 1982), and by other anorthositic rocks. Post-orogenic graben or half-graben are developed in the crystalline rocks and are filled with coarse, locally derived terrigenous clastic rocks; they underlie approximately the depressions occupied by Lake Melville and Double Mer.

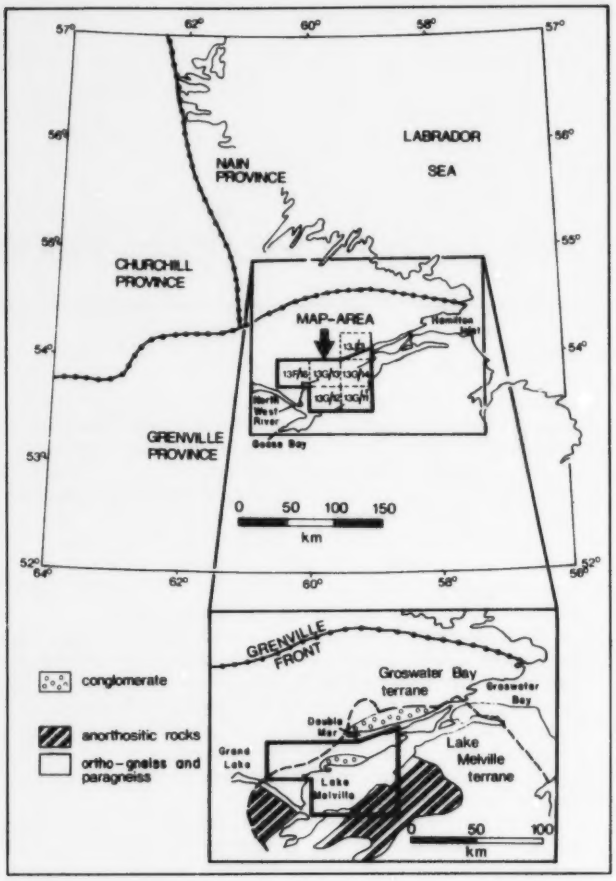


Figure 2. Location and geological setting of the map area.

Previous work.

Low (1896) and Kindle (1924) described the rocks of the Lake Melville area as undifferentiated Precambrian rocks and coarse red sandstone of presumed Cambrian age, the Double Mer Formation. Eade (1962; at 1:506 880 scale) and Stevenson (1967, at 1:253 440 scale; 1970, at 1:250 000 scale), reported mostly tonalitic and granitic gneiss commonly with a steeply dipping fabric, intruded by weakly deformed monzonite to granite bodies. They outlined the Mealy Mountains anorthosite massif. Stevenson inferred that the rocks were of Helikian or Aphebian age; he attributed a sedimentary origin to the bulk of the tonalitic gneiss. From mapping in 1982, rocks interpreted to be derived from sedimentary protoliths are present but generally in small amounts, and the granodioritic (rather than tonalitic) gneiss is inferred to be chiefly from a plutonic protolith; a preliminary account of the data supporting this reinterpretation was given by Erdmer (1983).

Approximately 200 km² of the isthmus between Lake Melville and Double Mer were mapped at 1:50 000 scale by Bailey (1979, 1980), who recognized a variety of gneissic, migmatitic and granitoid rocks. Although the distribution of rock types on Bailey's map is not entirely compatible with present results, most of the units he defined can be correlated with those recognized in this study. Mapping at 1:250 000 scale of the Mealy Mountains by Emslie (1976; personal communication, 1982) has shown that the complex includes anorthositic, gabbroic and monzonitic rocks that are largely unstrained.

Seismic profiler transects of Lake Melville carried out in 1972 revealed large northeast-trending horst and graben structures that are inferred to offset submerged strata of the Double Mer Formation (Grant, 1975).

Regional geochemical lake sediment and water survey was carried out by the Geological Survey of Canada in the Lake Melville area under a joint program with the Newfoundland Department of Mines and Energy (Geological Survey of Canada, Open File 511, 1978). Some of the lake sediment samples were anomalously high in uranium, and follow up work showed the presence of uranium mineralization at three localities on the isthmus separating Lake Melville from Double Mer (McConnell, 1978, 1979a,b; Kerswill and McConnell, 1979, 1982). A summary of mining exploration work is given in the discussion on economic potential of the area.

Recent systematic mapping of the surrounding regions has been carried out at 1:250 000 scale by Emslie (personal communication, 1982), and at 1:100 000 scale by Gower (1980, 1984), Gower et al. (1981, 1982a, 1982b), Gower 1983a,b), Ryan (1982), Ryan et al. (1981, 1982), and Wardle and Ash (1984).

Physiography and exposure.

The area includes most of the Lake Melville Lowland (Kindle, 1924), an irregular plain at an average elevation of 15 to 60 m; part of the Mecatina Plateau (Bostock, 1970), a rough, uneven bedrock peneplain at elevations ranging from 300 to 600 m; and a portion of the Mealy Mountains, where bare, flat-topped peaks rise sharply to more than 1100 m along the south side of the Lake Melville Lowland (Greene, 1974).

In the lowland and most of the plateau areas bedrock is covered by extensive glacial drift with associated eskers, drumlins and numerous small lakes whose outlines are controlled by moraines and dunes in places; most glacial striae have been obliterated by erosion, but available evidence indicates that the last ice movement was predominantly eastward.

Dense forest, mainly of black spruce, and swamps cover most of the low-lying areas, making foot travel slow and difficult. Outwash plains of sand and gravel up to several square kilometres occur at the mouths of the largest valleys. Bedrock exposure is poor north of Lake Melville except along the shoreline and on a few bare ridge tops at the eastern extremity of the area, where exposure is good. For these reasons, as in much of the Labrador interior, contacts between map units are generally not exposed; available aerial photographs and aeromagnetic maps are of little help in estimating their position. In contrast, exposure is excellent in the Mealy Mountains.

Acknowledgments

Field work was carried out with the able help of Glenn Bursey, Chris Pinsent and Tony Power, then geology students at Memorial University of Newfoundland, and of Mark Wilson, a geology graduate of Carleton University.

Administrative staff of the Newfoundland Department of Mines and Energy, E. W. and E. J. Tuttle, performed their expediting and logistical duties in Goose Bay with competence.

A visit through the area adjacent in the east, which constituted a helpful introduction to the regional geology, was organized by C. F. Gower. His assistance in many practical matters and his contribution to discussions during the preparation of results are acknowledged. Manuscripts were critically read by C. F. Gower, R. J. Wardle (Newfoundland Department of Mines and Energy) and R. F. Emslie (Geological Survey of Canada); their comments have contributed to the report in its present form.

UNIT DESCRIPTIONS

The geological infrastructure of the area is dominated by two compositionally distinct, heterogeneous, highly deformed gneiss complexes of Paleohelikian or earlier age. These contain small remnants of inferred metasedimentary origin, whose age is uncertain but may be comparable to that of most of the gneiss, and structurally younger metaplutonic rocks. A large early Paleohelikian biotite granite pluton and a Paleohelikian anorthosite massif each intruded one of the gneiss complexes.

A gently southeast-dipping mylonite zone separates the gneiss complexes. Inferred northwesterly thrusting along the zone may be of Grenvillian or Neohelikian age. Post-Grenvillian block faulting produced the Lake Melville graben, and brittle strain at its boundaries overprints the mylonite. The graben is floored by red conglomerate and sandstone of mostly local provenance, suspected to be of Hadrynian age.

The following section presents descriptions of units recognized in the region on the basis of field observations, petrography, chemical characteristics and modal estimates from stained slabs of the granitoid rocks. The chemical composition (major, minor and trace elements, CIPW norm and differentiation index for the metaplutonic rocks) of nearly 400 samples from the area is summarized in Table 1[1]. A complete computer listing of analytical results is on file with the Newfoundland Department of Mines and Energy. A plot of the average composition of the granitoid units is given in Figure 3.

[1] see page 27

Figure 3. Classification and nomenclature of (metaplutonic) units according to mineral content of mean bulk composition, following the classification of Streckeisen (1976). Although the Streckeisen classification is based on modal mineral content, normative amounts of Qz, Or, and (Ab + An) have been used here. Optical determination in thin section and microprobe analyses show that the anorthite content of plagioclase is always greater than 5 in all units (i.e. there is no modal albite) and the error introduced by combining all normative Ab with An is therefore assumed to be negligible. Average bulk compositions of units were also compared to the values reported by LeMaitre (1976) for a variety of igneous rocks (this comparison is useful in a qualitative sense; however, rock names used for the classification are those of the original author(s) and do not follow Streckeisen (1976)). Units are labelled as in Table 1.

Units Hgr-bg, Hgr-ag, Hgr-gd

These units include a variety of polydeformed, strongly heterogeneous gneissic rocks whose composition ranges from granite to granodiorite. Rock types intermediate between these various unit "end members" underlie most of the area between Lake Melville and Double Mer.

Unit Hgr-bg is pink, reddish grey, or buff, medium to coarse grained, granoblastic, well banded biotite granitic gneiss. Grain size varies noticeably (less than 1 mm to over 5 cm) within and between outcrops. Plagioclase is generally sericitized; hornblende, secondary muscovite and chlorite are commonly present. Sphene occurs as rims around fine grained ilmenite. Allanite, in rare euhedral zoned grains up to 2 mm across, is a characteristic accessory. Migmatite segregations are developed parallel to the gneissosity within individual folia, in hand specimen and in outcrop, and are folded in places; pegmatite veins and dykes truncate the gneissosity, and some are themselves folded (Fig. 4).

Unit Hgr-ag comprises salmon to cream, fine to medium grained aplitic foliated rock, microgranite, and their gneissic equivalents, whose overall composition is close to that of unit Hgr-bg. Hornblende is generally absent. Plagioclase is almost invariably sericitized; sphene, zircon, and ilmenite mantled by sphene are common accessory phases. These more homogeneous, leucocratic rocks are interleaved within unit Hgr-bg in many outcrops as bands and lenses parallel to the foliation. They are differentiated in Figure 1 in areas where they constitute more than half of the exposed bedrock, mainly to the north and west of Charley Point.

Unit Hgr-gd is grey (black and white), medium grained, well layered, equigranular, garnetiferous biotite granodiorite gneiss than occurs in five separate small lenses, each less than 1 km across and interleaved in unit Hgr-bg (Fig. 5). Plagioclase (average of An_{35}) is sericitized; ilmenite and zircon occur in small amounts. Epidote is present to the north of Valley Bay, either as a broad rim around allanite grains or as small euhedral grains. Slivers or bands of coarse grained micaceous garnetiferous amphibolite are associated with the westernmost of the two granodioritic lenses exposed on the shore of Double Mer. One outcrop of amphibolite contains hypersthene. Garnet is characteristically mauve in these lenses, and some crystals contain fine acicular inclusions that appear to be sillimanite; an attempt to confirm this through microprobe analysis was unsuccessful because of the small size of the inclusions. Unit Hgr-gd is interpreted to be of supracrustal origin (metasedimentary, possibly with some volcanic rocks that are now amphibolite).

Units Hgr-bg and Hgr-ag include abundant layers and lenses of amphibolite. Some amphibolite bodies are partially digested layers and lensoid, heterogeneous boudins, and others are clearly crosscutting metadykes; it is clear that at least two (and possibly more) protoliths exist (Fig. 6) and that two or more episodes of deformation affected the rocks. The gneiss thus has a true polyorogenic character. The less-deformed amphibolite dykes may be equivalent to the map-scale bodies of unit Ham.

Orthopyroxene is present in granitic gneiss included in unit Hgr-bg within the Sebaskachu Bay mylonite zone (see description in the section on structure). The large hypersthene porphyroblasts (up to 1 cm) are mostly pretectonic, and are weakly recrystallized. The orthopyroxene-bearing rocks in the mylonite zone are interpreted to be deeper, granulite grade equivalents of the other rock types of unit Hgr-bg brought up along the mylonite zone.

As units Hgr-bg, Hgr-ag and Hgr-gd include rocks of widely differing origin (i.e. metagranitoid, metasediment, mafic dykes, etc.) that have contact relations so intricately involved that they are ambiguous, they constitute a gneiss complex rather than a suite of easily separable (sub)units on the scale of the map. This gneiss complex may also

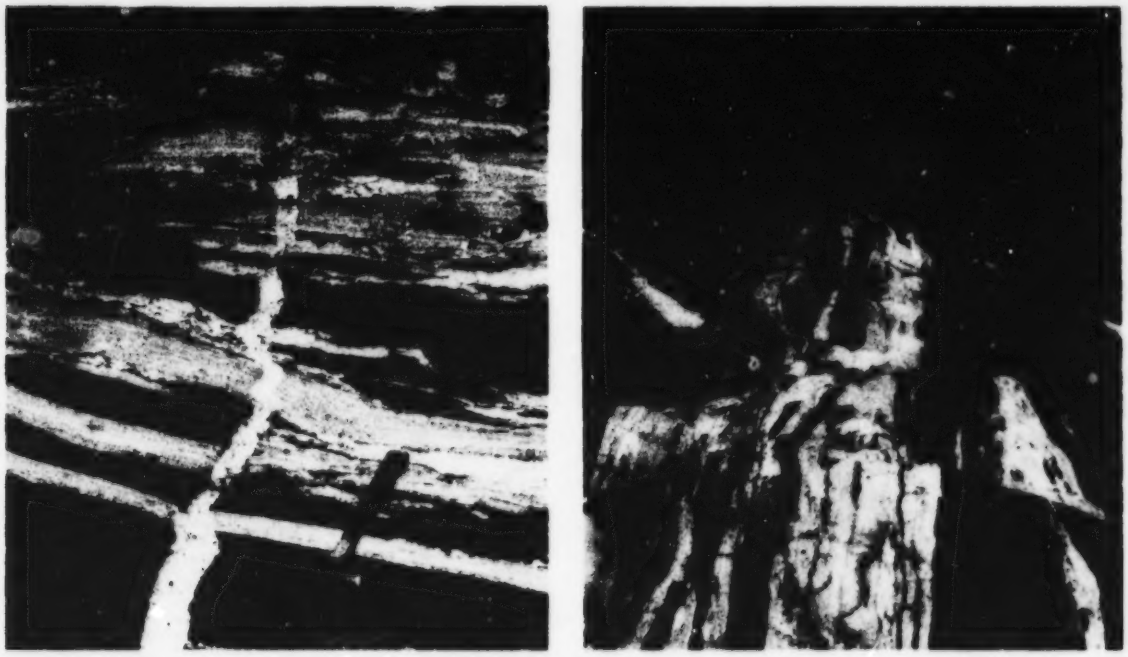


Figure 4. Outcrops of the granitic gneiss complex (unit Hgr-bg) on the shore of Lake Melville (right) and Double Mer (left). Large amounts of pegmatite and migmatite are included in this polydeformed, heterogeneous unit. (GSC 204175-A, 204175)

Figure 5. Garnetiferous, well banded granodiorite gneiss (unit Hgr-gd), inferred to be of metasedimentary origin, with a garnetiferous amphibolite layer inferred to be of igneous origin. Garnet is characteristically mauve, and contains very fine grained acicular inclusions that may be sillimanite. Outcrop on the south shore of Double Mer. (GSC 204175-5)

Figure 6. Boudinaged amphibolite lenses (interpreted as early dykes) are cut by nearly planar pegmatite dykes, that are in turn cut by nearly unstrained amphibolite dykes (outside field of view). Unit Hgr-bg, south shore of Double Mer. (GSC 204175-R)

contain rocks of more than one age, and is likely to have had a deformation history which includes both Grenvillian and earlier phases. The bulk of the complex is interpreted as a granitoid terrane of pre-Grenvillian age. It is correlated with units 1 to 6 of Bailey (1980): grey granitic gneiss, amphibolite gneiss, mafic gneiss, granite gneiss and migmatite, leucogranite and transitional rock types assumed to be of Archean to Aphebian age. It is similar to parts of the heterogeneous gneiss recognized on strike to the east (unit 5 of Gower et al., 1981), informally referred to as the Lake Melville gneiss.

Units Hgd-g, Hgd-mu, Hgd-ky

These units also form a gneiss complex, of overall granodioritic composition, underlying most of the western part of the region.

Unit Hgd-g is medium grained, grey (salt-and-pepper textured), well layered biotite and hornblende granodiorite gneiss (Fig. 7). Biotite is deeply pleochroic olive green to greenish brown, and commonly chloritized. Plagioclase (An_{15-25}) is locally heavily sericitized; zircon is common. Scapolite occurs in a few places as large (2 mm) altered grains. Epidote and allanite are characteristic accessory minerals; garnet, muscovite and sphene occur in places. Strips of pink migmatite are developed along the foliation (Fig. 8). In contrast to the granitic gneiss complex, amphibolite is rare, and appears to be confined to thin melanocratic layers within the gneiss. However, this may result from the fact that the unit is only seen inland. These granodioritic rocks are correlated with similar rocks to the west, mapped by Ryan et al. (1981; parts of units 1 and 13) and are comparable to the Groswater Bay gneiss (informal term, Gower, personal communication, 1982) farther east. A U-Pb age of 1680 Ma has been obtained from zircon in the unit (Krogh, 1983 report to the Newfoundland Department of Mines and Energy, see Appendix A).

Unit Hgd-mu is restricted to small, isolated lenses less than 1 km across that appear to be elongated along the foliation within unit Hgd-g. It consists of well banded, medium to coarse grained, light pink, quartz-feldspar-muscovite gneiss. Plagioclase (An_{30}) is sericitized; rare biotite is slightly altered to chlorite in many outcrops. Some of the unit may have been partially melted from the surrounding gneiss. Other protoliths may include feldspar-rich rocks of igneous or sedimentary origin. Its age is assumed to be close to that of unit Hgd-g.

Unit Hgd-ky includes distinctive, granoblastic, finely migmatite-banded, kyanite-bearing quartzofeldspathic biotite gneiss; the banding is characteristically disharmonically folded in outcrop. Plagioclase (An_{10-20}) is mostly fresh; biotite and muscovite are coarse grained and fresh. This rock type occurs in two rafts about 1 km across strike, along the western margin of the large granite pluton (unit Hpxg) north of Mulligan Bay and within Hgd-g near the western extremity of the map area. Kyanite occurs as bluish green blades up to 1 cm long, or more commonly as very fine grained aggregates with biotite and muscovite, that can be identified only in thin section (Fig. 9).

Figure 7. Granodiorite gneiss (unit Hgd-g), about 20 km northwest of Sebaskachu Bay. This rock is noticeably more homogeneous than the rock of unit Hgr-bg (granitic gneiss complex; see Fig. 6). (GSC 204175-0)

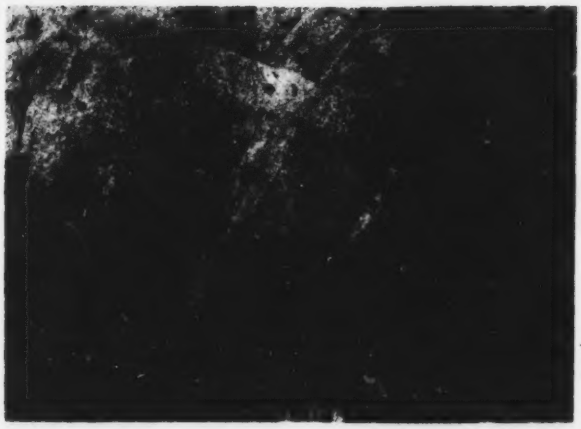


Figure 8. Migmatite developed parallel to the gneissosity in unit Hgd-g (granodiorite gneiss), about 20 km northwest of Sebaskachu Bay. (GSC 204175-D)

Rocks of unit Hgd-ky appear to have undergone the same degree of deformation as the gneiss of unit Hgd-g but their relative age is unclear. Unit Hgd-ky is interpreted to be derived from a sedimentary protolith and is correlated with similar rocks to the west, considered to be of Aphebian or earlier age by Ryan et al. (1981; unit 2). Unit Hgd-ky is interpreted as a supracrustal sequence either deposited on a granodiorite basement, or intruded by pretectonic granodiorite bodies.

Unit Ham

Unit Ham includes medium grained amphibolite, micaceous amphibolite, and minor clinopyroxene amphibolete gneiss that occur as elongate, thin and wispy (on the scale of the map) bodies interleaved in the gneiss complex of units Hgr-bg, Hgr-ag and Hgr-gd (Fig. 10). Clinopyroxene occurs in many outcrops. Secondary actinolite is present in two places. These rocks are correlated with unit 9 of Bailey (1980), medium to fine grained amphibolite derived from metagabbro and metadiabase and inferred to be of Aphebian to Helikian age.

The rocks of unit Ham are interpreted as former mafic dykes (gabbro or gabbronorite, on the basis of normative mineralogy in Table 1). From the range of strain they exhibit, their protoliths are considered to be of Helikian to Grenvillian age.

Units Hmd-qm, Hmd-gm, Hmd-gra

Units Hmd-qm, Hmd-gm and Hmd-gra include three suites of mafic, granoblastic gneissic rocks that occur in small isolated lensoid masses underlying areas of at least 10 km^2.

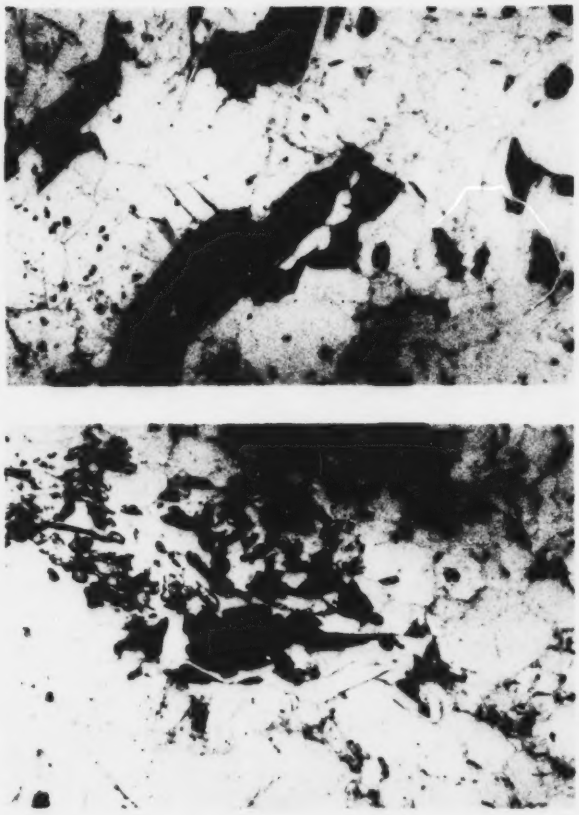


Figure 9. Kyanite crystals in quartzofeldspathic gneiss (unit Hgd-ky) inferred to be of metasedimentary origin. The fine grained form (bottom) is more common than the coarse grained form with blades up to 2 cm long (top).
East-west field of view 2 cm (top), 1 cm (bottom). Photomicrographs under plane light.
(GSC 204175-N,L)

Unit Hmd-qm is medium grained, dark, dense, hornblende quartz monzodioritic gneiss, garnet amphibolite and minor foliated metagabbro. It is exposed in a large area northwest of Mulligan Bay, and in several smaller lenses within the gneiss of unit Hgr-bg between Lake Melville and Double Mer. Although the rock is homogeneous on the scale of each outcrop, most of the unit has a composition intermediate between two or more of the mafic end-members listed above. Plagioclase is An_{30} or less. Chlorite-amphibole schist that occurs in some outcrops is interpreted as a product of retrograde metamorphism. The contacts of unit Hmd-qm with the surrounding gneiss of unit Hgr-bg appear to be gradational, diffuse boundaries across which rock types are repeated and intermixed on a range of scales. Foliations in both units are parallel to the contacts.

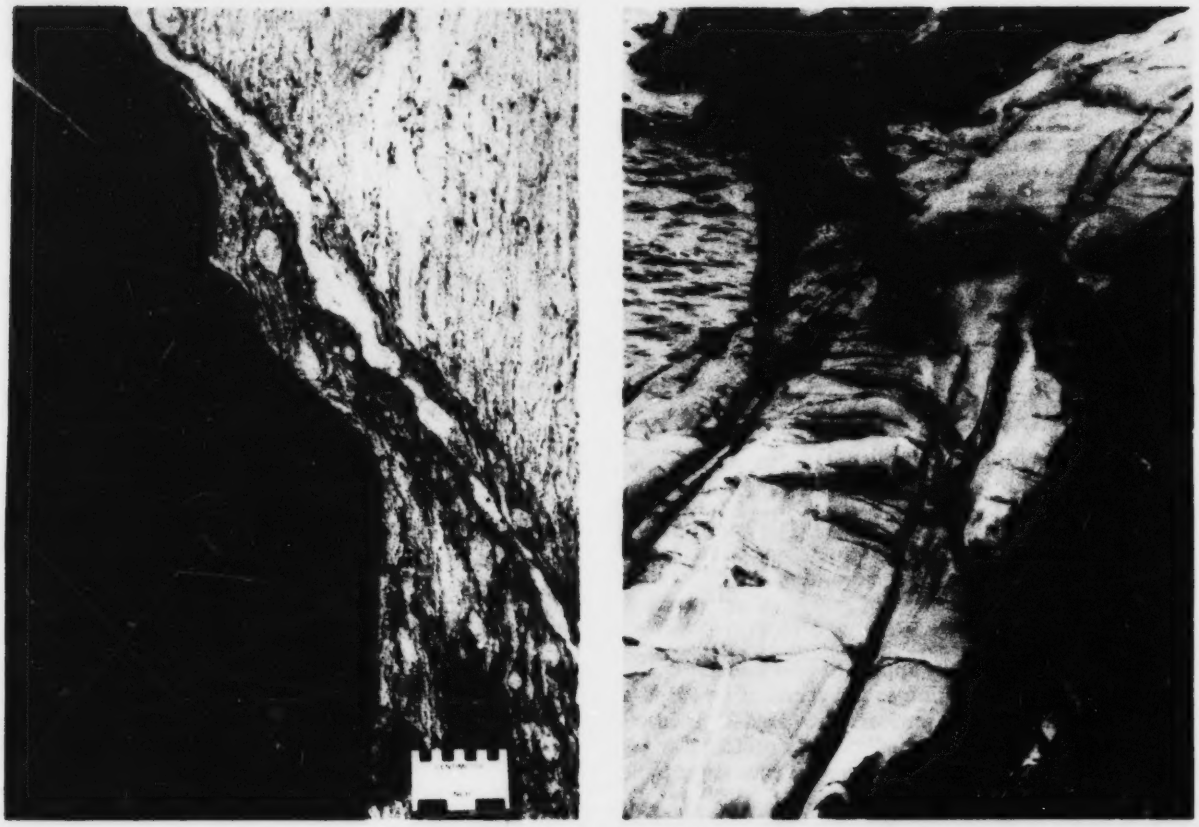


Figure 10. Amphibolite dykes (unit Ham) in the granitic gneiss complex (unit Hgr-bg; right), and at the margin of a body of augen gneiss (unit Hkag; left). Outcrops on the south shore of Double Mer. (GSC 204175-C,V)

Unit Hmd-gm is medium grained, dark, hornblende monzodiorite to garnetiferous hornblende monzodiorite gneiss. Clinopyroxene and epidote are common accessories. Plagioclase has an average An content of 40%. Scapolite is characteristic, but sparse. The unit occurs as two separate lensoid bodies, each less than 5 km long, surrounded by granodiorite gneiss of unit Hgd-g. Contacts are not exposed; the units are inferred to be interleaved, as foliation attitudes in the few outcrops observed are parallel. The age of units Hmd-qm and Hmd-gm is unknown, and their relation to other units is unclear. Some of the bodies may be metamorphosed mafic intrusions (leucogabbro or leucogabbronorite, from normative mineralogy) of Aphebian or younger age into the gneiss complexes and others may be mafic phases of the surrounding rocks.

Unit Hmd-gra is distinctive, dark, homogeneous, fine to medium grained, equigranular, two-pyroxene-plagioclase-quartz granulite gneiss of overall dioritic to monzodioritic composition. It occupies several square kilometres to the southeast of Double Mer. Plagioclase has a characteristic waxy, brownish green appearance. Biotite, hornblende and K-feldspar occur as accessory minerals. Many hypersthene and diopside grains have triple junctions with plagioclase (Fig. 11). The unit is in contact with gneiss of unit Hgr-bg in the east, and is overlain by drift in the west. Foliation attitudes on either side of the contact with unit Hgr-bg are discordant and the contact is inferred to be sharp. However, the local presence of both rafts and injected masses of quartzofeldspathic material in the granulite implies some deformation and mixing. The boundary may have been either a fault or an intrusive contact, reworked and masked by later metamorphism.

Rock types similar to those of unit Hmd-gra occur in a large area about 10 km to the north, where they were interpreted by Stevenson (1970; unit 4a — pyroxene granulite) as high grade paragneiss, because of "relict primary bedding readily apparent". No comparable features of unequivocal sedimentary origin are apparent in the granulitic rocks here. Their protolith is interpreted to be mafic igneous rock (leucogabbro) of Helikian or earlier age whose grade of metamorphism differs in part from that of the surrounding gneiss. The unit appears typical of mafic granulitic rocks occurring along the length of the Lake Melville terrane thrust front (Gower, personal communication, 1983).

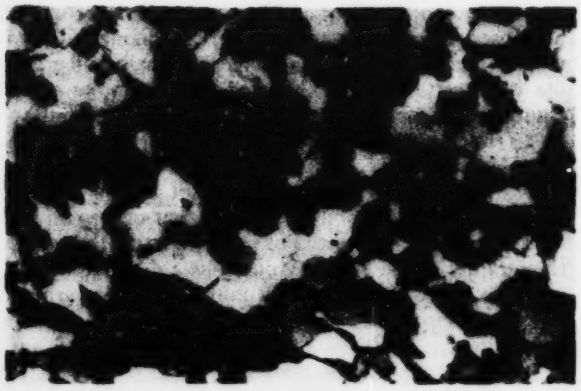


Figure 11. Two pyroxene granulite (unit Hmd-gra) from an outcrop 5 km west of the head of Double Mer. Photomicrograph under plane light. East-west field of view 2 cm. (GSC 204175-M)

Units Hmxg, Hkag

Units Hmxg and Hkag include distinctive, homogeneous, coarse grained orthogneiss exposed in two elongate bodies near the northeast extremity of the study area, between Lake Melville and Double Mer.

Unit Hmxg is pink, leucocratic, locally megacrystic (K-feldspar), biotite and hornblende granite orthogneiss that is moderately foliated; it is well exposed on the shoreline 2 km east of Charley Point (Fig. 12). Plagioclase is commonly sericitized; ilmenite, mantled by sphene, is a widespread accessory. The unit has sharp, structurally conformable contacts with the surrounding gneiss of unit Hgr-bg. It is correlated with parts of unit 8b of Bailey (1980), coarse grained augen granodiorite interpreted to be of Aphebian to Helikian age.

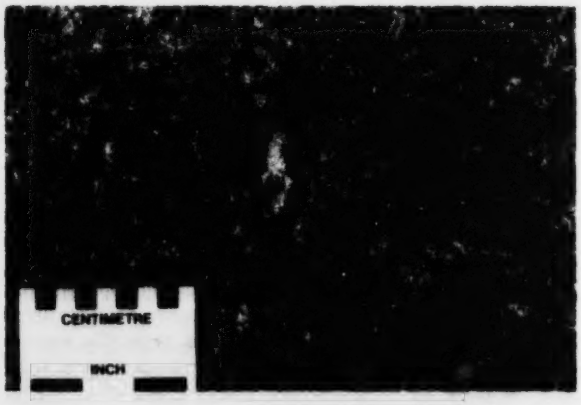


Figure 12. Pink biotite and hornblende granite (unit Hmxg); a characteristic megacrystic phase is developed in many places. Outcrop on the shore of Lake Melville, 2 km east of Charley Point. (GSC 204175-Q)

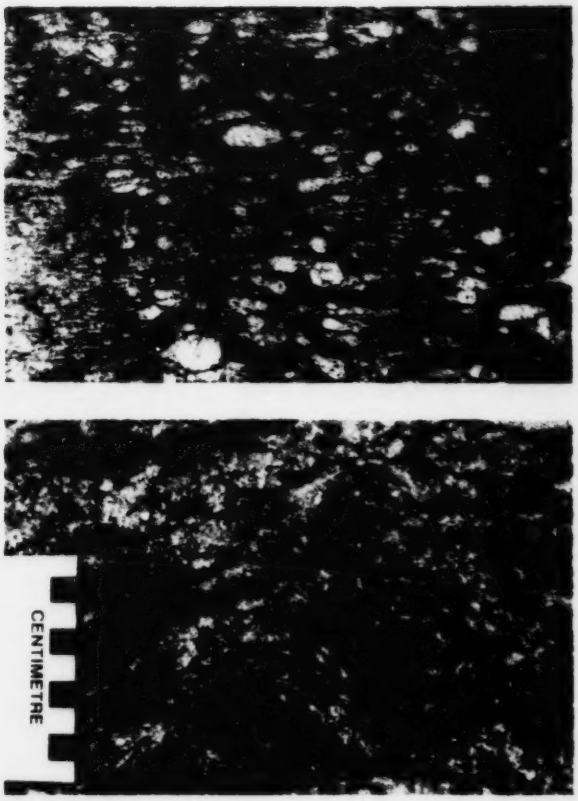


Figure 13. Grey augen biotite granite orthogneiss (unit Hkag), on the south shore of Double Mer (top). A concentric zoning of K-feldspar is characteristic of most of the crystals in the unit (bottom). (GSC 204175-E, B)

Unit Hkag comprises grey augen (K-feldspar and plagioclase), biotite granite orthogneiss that displays a strong foliation. The augen reach over 5 cm across the foliation; the K-feldspar crystals are characteristically concentrically zoned (Fig. 13) with sericitized plagioclase inclusions. The unit is well exposed on the south shore of Double Mer. It is homogeneous and relatively resistant to weathering, and can be readily traced inland to the east. It is correlated with parts of unit 3 and with unit 8a of Bailey (1980), porphyroblastic granitic gneiss and hornblende granite inferred to be of Archean to Helikian age. The contacts between the augen gneiss and the surrounding gneiss (unit Hgr-bg) are sharp, with little variation in grain size of either unit, and parallel to the foliation in both units.

The metaplutonic rocks of units Hmxg and Hkag may be intrusive bodies of Paleohelikian age, emplaced into the older gneiss and deformed before or during the Grenvillian Orogeny. They appear to be equivalents of large megacrystic granodiorite and granite bodies exposed farther east, to which Gower et al. (1981; unit 6) assigned a Helikian or earlier age.

Unit Hhmd

Unit Hhmd is pink, well foliated, medium grained hornblende and biotite leucomonzodiorite to diorite gneiss. It occurs in an isolated outcrop immediately north of Sebaskachu Bay, where it is poorly exposed. Orthopyroxene is present as coarse, unstrained porphyroblasts. In spite of its close proximity to the mylonitic orthopyroxene-bearing rocks to the north, the rock displays almost no strain. Whether this is because of the regional heterogeneity of strain or because of age differences is unknown; the scarce data permit only speculations of age and lithological affinity. The unit is orthogneiss of uncertain age, inferred to be interleaved in the gneiss of unit Hgr-bg; its age may be Helikian or older. The unit may have stratigraphic equivalents in the area between Lake Melville and Double Mer, as it appears similar to parts of units Hgr-bg and Hmd-gm in that area; it is even possible that its differentiation as a unit may not be justified as the orthopyroxene is clearly not primary, and it may be a deeper crustal level equivalent of parts of the granitic gneiss complex brought up along the mylonite zone.

Mealy Mountains Intrusive Suite

Rocks of this suite are exposed to the south of Lake Melville only, and their relation to other units in the map area is unknown. About 10 km east of the map area these anorthositic rocks are inferred to be faulted against tonalitic and granodioritic gneiss that is correlated with the gneiss of unit Hgr-bg; although the age of the bounding fault is unclear, its map pattern suggests that it follows at least in part an older intrusive contact.

Four units were recognized by Emslie (1976; personal communication, 1982). Southwest of Etagaulet Bay occur fresh, dark grey, medium to coarse grained, commonly massive or moderately to strongly layered labradorite leucotroctolite and anorthosite, with minor troctolite, olivine gabbro and leuconorite (*unit Hlct*). East of Etagaulet Bay, the rock is mainly fresh andesine (An_{50-52}) leuconorite and anorthosite (*unit Hlcn*) (analysis of three samples for this study shows their average composition to be transitional between anorthosite and monzodiorite); it is dark, medium to coarse grained, locally very coarse grained (pyroxene crystals range from 2 cm to over 1 m), and mainly massive but locally moderately to strongly layered. Thin sections show that giant crystals of orthopyroxene commonly have exsolved plagioclase lamellae which, along with other textural features, suggest that the megacrysts were brought up from depth with the basic magma after crystallizing from a deeper melt. Separating these two units are younger monzonitic rocks (*unit Hmnz*) of more variable composition. They are predominantly massive, medium grained, equigranular pyroxene and fayalite monzonite, with minor quartz monzonite, granite, and monzodiorite. The rocks have a distinctive greenish lustre on fresh surfaces, or range from grey to pink and deep red. They are weakly recrystallized in places. Dykes of this unit invade the older basic rocks, especially near the contacts, where blocks of anorthosite are included in the monzonitic rocks.

In the southern part of the map area, Emslie (op. cit.) has observed several outcrops where the monzonite contains abundant xenoliths and screens of gneiss and granulite of uncertain origin, inferred to be samples of the country rock incorporated into the intrusive massif.

Truncating all the above rocks, the Mealy olivine diabase dykes (*unit Hod*) range from 1 cm to over 50 m across strike. They form a swarm of fine to medium grained bodies with chilled margins that occupy in part the strong east-northeast joint set dominating the surface topography of the Mealy Mountains.

The rocks of the complex fall into two age groups. The anorthositic and monzonitic rocks crystallized at approximately 1640 Ma, although K-Ar hornblende ages of 1400-1500 Ma suggest that cooling was relatively slow (Emslie, 1982). The Mealy dykes have yielded a Rb-Sr age of 1380±4 Ma (Emslie et al., 1983). K-Ar whole rock ages of 1123±50 and 1078±48 Ma (Gittins, 1972) and 1222±101 Ma (Fahrig and Loveridge, 1981) for dykes near Eskimo Paps may result from reheating during the Grenvillian Orogeny, at about 950 Ma, or from earlier final uplift and closure of the K-Ar system.

Units Hqmg, Hgqm, Hpxg, Hbm

These units include a suite of granitic, monzonitic and monzodioritic rocks that occur in a large, weakly deformed pluton in the north-central part of the area and in two nearly unstrained small stocks that may be satellites of the main body in the western part of the region. Relatively coarse grained zircon (several millimetres) is present in all these units, with minor apatite and opaque minerals. Plagioclase characteristically has a composition of An_{20} or less. Primary crystallization textures are preserved in most of the unit. Biotite is brown to reddish brown.

Unit Hqmg is pink, coarse grained, massive to weakly foliated biotite quartz monzonite and granite that occurs in a stock about 3 km across, to the north of Mokami Hill. Parts of the body are homogeneous hornblende- and sphene-bearing biotite quartz monzonite, others are clinopyroxene- and garnet-bearing biotite granite similar to unit Hpxg.

Unit Hgqm is resistant, massive to well foliated, buff, coarse grained hornblende granite to quartz monzonite (Mokami quartz monzonite) that underlies Mokami Hill. Biotite, garnet and allanite are common accessories; quartz is characteristically smoky brown.

Unit Hpxg comprises homogeneous, coarse grained, pink to buff biotite granite occurring in a pluton at least 20 km across (in a north-south direction) extending beyond the northern boundary of the map area. Clinopyroxene and garnet are two characteristic accessory minerals, concentrated in small clots drawn out along the foliation. They are inferred to be primary phases recrystallized during metamorphism. The pluton is generally weakly foliated, although it is nearly massive in places and difficult to distinguish from its gneissic host (mainly unit Hgd-g) because of strong boundary deformation.

Unit Hbm includes buff to brown, massive, coarse grained, equigranular mafic monzodiorite that underlies the west flank of Mokami Hill. The rock is distinguished

from unit Hgqm by an appreciably higher hornblende content, by the presence of large clinopyroxene and garnet aggregates and by the virtual absence of modal quartz. Plagioclase has an average composition of An_{13}. The unit is interpreted as a mafic phase of either the Mokami stock or the large granite pluton (unit Hpxg).

Rocks of units Hgqm, Hqmg, Hpxg and Hbm belong to a suite of high-K-feldspar granite, quartz monzonite and monzodiorite plutons interpreted to be coeval, and that may be comagmatic. From map patterns, all three bodies clearly crosscut the surrounding gneiss of unit Hgd-g, and are inferred to postdate the development of most of the foliation. Radiometric dating of a sample from the large pluton (unit Hpxg) has yielded a U-Pb (zircon) age of 1632 Ma (Krogh, 1983 report to the Newfoundland Department of Mines and Energy, see Appendix A); from field correlation with granite plutons of similar characteristics occurring to the north (Benedict Mountains Intrusive Suite; Gower, 1981) that were emplaced between 1650 and 1550 Ma, units Hqmg, Hgqm, Hbm and Hpxg are probably all of Paleohelikian age. The relatively weak strain they display is considered to be the effect of the Grenvillian Orogeny.

Units Hum, Hga

Units Hum and Hga include mafic, ultramafic and gabbroic rocks in two widely separated areas. *Unit Hum* comprises resistant, medium to coarse grained, equigranular, massive olivine hornblendite and minor olivine-bearing ultramafic rock types occurring in a small intrusive body west of Sebaskachu Bay. The body appears ellipsoidal in plan, with a long axis of about 2 km. Thin sections show that primary features such as olivine layering, ophitic texture and orthopyroxene crystals with minute opaque inclusion layers are preserved. Plagioclase has an average composition of An_{27}. Garnet, hornblende, biotite, serpentine and K-feldspar appear to be metamorphic or alteration minerals. Two analyses (Table 1) show great compositional variability, and bulk chemistry (e.g. 1.5% Al_2O_3, 31.7% MgO and 38.3% SiO_2) typical of many peridotites (LeMaitre, 1976). The unit is interpreted either as a cumulate phase or a differentiate of a gabbroic magma. The rocks show little strain, and although the hornblendite is well recrystallized, the preservation of graded inclusion layering in pyroxene in the other phases suggests that the entire intrusive body largely escaped the deformation recorded in surrounding rocks. The age of these rocks is unknown; the positive relief and sharp outline of the body on air photographs suggest that it truncates sharply the gneiss of unit Hgd-g.

Unit Hga is medium grained, massive, equigranular gabbro exposed on a small distinctive promontory on the south shore of Double Mer, over an area of about 200 m^2. Thin sections show that fresh, well twinned plagioclase and augite outline an ophitic texture; hornblende is abundant, and appears to have formed at the expense of clinopyroxene. Biotite and opaque grains occur sparingly. Within 10 to 50 cm of the contact with the surrounding gneiss of unit Hgr-bg, the gabbro is progressively more strained, and displays a strong foliation at its margin. This fabric is parallel to that of the gneiss. The body is interpreted as an intrusive mass older than the latest deformation.

Rocks of units Hum and Hga have many of the petrological features and some of the field characteristics of parts of the Michael Gabbro, which is exposed in distinctive, elongate bodies in the region to the north (Fahrig and Larochelle, 1972; Gower, 1981). A Rb-Sr age of 1461±96 Ma has been obtained for the Michael Gabbro by Fahrig and Loveridge (1981). If the slightly strained gabbroic rocks in the map area are stratigraphically equivalent to the Michael Gabbro, they are also of Paleohelikian age.

Unit Hd

Unit Hd occurs as elongate, lensoid rock masses of plutonic habit interleaved in unit Hgr-bg in the area between Lake Melville and Double Mer. It consists of chalky weathering, leucocratic, pegmatitic, quartzofeldspathic rock (Fig. 14) for which the term diatexite was used in a descriptive sense in the field. K-feldspar is on average more abundant than either quartz or plagioclase; garnet is present in a few places. Biotite, the only mafic mineral, rarely exceeds 2%. The largest bodies are separated on the map, but many outcrops in the region where unit Hd occurs include a proportion of leucocratic pegmatitic layers noticeably higher than elsewhere in unit Hgr-bg (over 50% is common). These nearly homogeneous masses are largely undeformed; their contacts with the surrounding gneiss are nebulitic, and conform to the foliation in the latter. No clearly crosscutting contacts were observed. The unit is correlated with unit 10 of Bailey (1980), coarse grained leucogranite of Helikian age (inferred, by Bailey, to intrude all other rocks along existing planar fabrics).

Figure 14. Quartzofeldspathic "diatexite" (unit Hd), in an outcrop of the granitic gneiss complex to the north of Lake Melville. Uranium mineralization occurs in this unit at three sites. (GSC 204175-J)

Sillimanite occurs in one place in the unit (Gower, personal communication, 1982; in drill core collected by Northgate Exploration Ltd.), together with uranium mineralization (see economic potential). An examination of specimens from other outcrops revealed no other occurrences of sillimanite. Gower et al. (1981) have mapped sillimanite-bearing uraniferous metasedimentary gneiss to the east, considered to correlate with unit Hd in the present area and for which an Aphebian protolith appears likely. This suggests that unit Hd may be at least in part the product of melting of Aphebian or older sedimentary strata; as little strain is preserved in the rocks, this melting may have occurred during the Grenvillian Orogeny, and unit Hd would be of Grenvillian age.

However, if the high grade of metamorphism recorded by this unit is of Grenvillian age, pre-Grenvillian Rb-Sr age dates obtained in surrounding areas are difficult to explain. Although no direct evidence of the age of the Lake Melville terrane (granitic gneiss complex) in the map area is available, it is likely that most of it is of pre-Grenvillian age (as the Groswater Bay terrane and the Mealy Mountains complex, to the north and south) and that its high grade metamorphism is also pre-Grenvillian.

The nature of unit Hd — metamorphic segregation, partial melt or late pegmatitic phase — cannot be established directly in the field. An examination of the chemical composition of the unit shows that the quartz-orthoclase-plagioclase proportions (Fig. 3) and the unit's bulk composition (Table 1) are similar to those of its host, unit Hgr-bg (and to those of unit Hgr-ag). On this basis, it seems plausible that unit Hd is not a metamorphic segregation of unit Hgr-bg, by diffusion and solution, as differences in composition would be likely.

Unit Hd would thus be either a late pegmatitic phase of unit Hgr-bg, or a former partial melt of that unit whose composition would be almost identical to the starting granitic gneiss, formed at the time of highest metamorphism of the gneiss. However, the local presence of sillimanite implies that unit Hd is a thoroughly metamorphosed (diatexitic) sedimentary succession (see above) whose bulk composition was close to that of unit Hgr-bg.

These inferences are not conflicting if unit Hd is interpreted to have had more than one protolith. As neither major nor trace element distribution favours one origin over the other, it is concluded that some bodies are genetically related to unit Hgr-bg (as pegmatite or former partial melt) whereas others are high grade paragneiss. From the above evidence it is also concluded that unit Hd is of pre-Grenvillian age.

Figure 15. Top. Outcrop of arkosic sandstone of the Double Mer Formation, on the north shore of Lake Melville. The attitude of crossbeds suggests a north-northeast flow. (GSC 204175-T)
Bottom. Photomicrograph of a sample of the sandstone. Granitic rock fragments and a fine hematite-stained cement are characteristic. East-west field of view 2 cm; plane light. (GSC 204175-I)

Double Mer Formation (unit HaPdm)

This formation underlies the lowland north of Lake Melville. It was originally described in a locality 5 km north of the present area by Kindle (1924), in a 150-foot section eight miles east of the head of Double Mer. It is a succession of regularly bedded, well indurated, dull red to reddish brown, clast-supported polymictic arkosic sandstone (Fig. 15), pebbly sandstone, conglomerate, minor siltstone and shale. The angular to subrounded clasts are gneissic and plutonic rocks inferred to have originated from the surrounding crystalline terrane; the cement is hematitic, finely arkosic or silt-rich (Fig. 15). Rare, small flakes of fresh muscovite that are present between the clasts may be either partly authigenic or entirely secondary.

Neither the top nor the bottom of the formation is exposed; this is generally the case in the four areas of central Labrador (including the present one) where strata of this formation outcrop. North of Lake Melville, bedding attitudes outline a gently west-dipping homoclinal sequence. The regularity of bedding of the coarser grained strata over large areas and the consistent attitude of crossbeds in the finer grained layers suggest that the 15 to 20° dip is structural rather than depositional. Assuming that there is no repetition by faulting, this implies a total depositional thickness in excess of 5 km for the strata in the Lake Melville graben which are inferred to lie unconformably on Helikian and older rocks. Based on the projection of seismic reflectors, an estimate of 3-4 km was

made by Grant (1975) for the thickness of the beds submerged beneath Lake Melville.

An outcrop of sandstone reported by Bailey (1980) approximately 5 km west of Charley Point could not be located. Topographic evidence suggests that the Double Mer Formation underlies the coastal lowland from Lowland Point to Charley Point, as inferred by Bailey (1980), but no outcrops were found. Crossbedding in arkose in two localities on the north shore of Lake Melville suggests a north-flowing depositional current. Stevenson (1970) observed similarly oriented crossbeds in the rocks to the north of Double Mer.

The formation is younger than the metamorphism of Grenvillian age recorded in the surrounding rocks. No material permitting radiometric dating has been found. Samples of sandstone collected from five localities were processed for palynomorphs, but contained no recognizable microfossils (E. Erdmer, personal communication, 1982). Sample locations are given in Appendix B.

Low (1895), Kindle (1924), and Stevenson (1970) assigned a Cambrian age to the formation on the basis of lithologic similarity to the nearest exposed Lower Cambrian strata, the Bradore Formation of southern Labrador. However, lithologic evidence for a Cambrian age is inconclusive and the Double Mer Formation remains datable only as younger than the gneissic and intrusive rocks on which it lies. Further interpretation of its age might follow the dating of regional northeast-trending graben formation in central Labrador, or the recognition of the detrital products of the terrigenous strata in exploratory drilling in the sedimentary section offshore which would indicate when major erosion of these rocks occurred (Grant, 1975).

STRUCTURAL GEOLOGY

The structures visible in the region are diverse. In addition to the deformed planar fabrics and the multiple intrusive and crosscutting relations of rocks in the gneiss complexes, which suggest a protracted history of deformation, the Lake Melville area offers an example of a post-orogenic graben of regional extent.

The following section describes the major and minor structures observed in mapping, and offers an interpretation of their origin, age and significance.

Major structures

Based on structural style, the region may be divided into four main domains. Each of these domains is also a tectonostratigraphic assemblage (i.e., a suite of rocks, either physically continuous or reasonably inferred to have been so, whose overall characteristics imply deposition in a particular tectonic setting). These are the Mealy Mountains complex, the granitic gneiss complex (principally between Lake Melville and Double Mer), the granodiorite gneiss complex (west of Sebaskachu Bay) and the strata of the Double Mer Formation that form part of the Lake Melville graben.

Mealy Mountains complex

This complex displays few effects of regional deformation or metamorphism. Internal structures such as igneous layering and intrusive contacts between units are well preserved. The strong east-northeast joint set in part occupied by the Mealy dykes and a secondary north-northwest set that appears to be conjugate are undeformed. Because some dykes have locally sheared margins, late movement along the joints must postdate the emplacement of at least part of the dyke swarm (Emslie, 1976). However, this also suggests that dyke emplacement and joint development were nearly contemporaneous. The major joint sets can therefore be dated as Helikian; it is unlikely that they result from cooling of the intrusive rocks, as the dykes are approximately 250 Ma younger.

On the basis of observations in adjacent areas (see description of rock units), the relation of the Mealy Mountains massif to other rocks in the region is inferred to be intrusive. The absence of ductile strain in the rocks, which cooled at approximately 1640 Ma, implies that the massif behaved as a rigid body while the gneiss terranes around it were deformed during the Elsonian and Grenvillian events. The massif can be likened to a map-scale, pre-kinematic inclusion in a less competent host. A corollary is that deformation, assumed to be mostly Grenvillian, was too weak to affect the anorthosite massif even mildly.

Granitic gneiss complex

The granitic gneiss complex between Lake Melville and Double Mer includes rocks of several units and constitutes a discrete tectonic assemblage characterized by a distinct, east-trending, apparently planar, vertical structural grain.

Ductile deformation has affected all the rocks of the complex. All units that can be traced on the map are elongated in an east-northeast direction; this map-scale fabric is inferred to result from an episode of horizontal north-northwest compression which flattened originally massive intrusive bodies (e.g. orthogneiss of units Hmxg and Hkag), and is implied to have rotated existing planar fabrics and tightened earlier folds into isoclinal structures. No earlier fabric elements of consistent orientation appear to be preserved on the scale of the map. The amphibolite dykes in units Hgr-bg and Hgr-ag provide evidence of a polyorogenic history; they also provide a means to differentiate pre-dyke structures (probably pre-Grenvillian) from post-dyke structures (post-Grenvillian?). Both the dykes and the slightly strained orthogneiss units have the potential to be important time markers in the gneiss complex.

An alternative to the interpretation of a simple easterly trending planar fabric, based on the results of a scintillometer survey (see discussion of economic potential), on Stevenson's (1970) interpretation and on the interpretation of Bailey (1980), is that tight east-northeast-trending synforms and antiforms are developed in the granitic gneiss complex.

Bailey's (1980) map shows two major folds outlined

by the main planar fabric of the strained units of the area. Because of the lack of exposure, structural evidence for these folds is tenuous. However, the style of deformation suggested by Bailey is compatible with the outline of a zone of high radioactivity between Lake Melville and Double Mer discovered in this study (see Fig. 20 and discussion of economic potential). Figure 16 illustrates the model, obtained by integrating broadly Figures 1 and 20. It suggests the existence of a major antiform through the area, cut by a major fault along Valley Bay. The distribution of rock types in the region can thus be interpreted in more than one way from the available data.

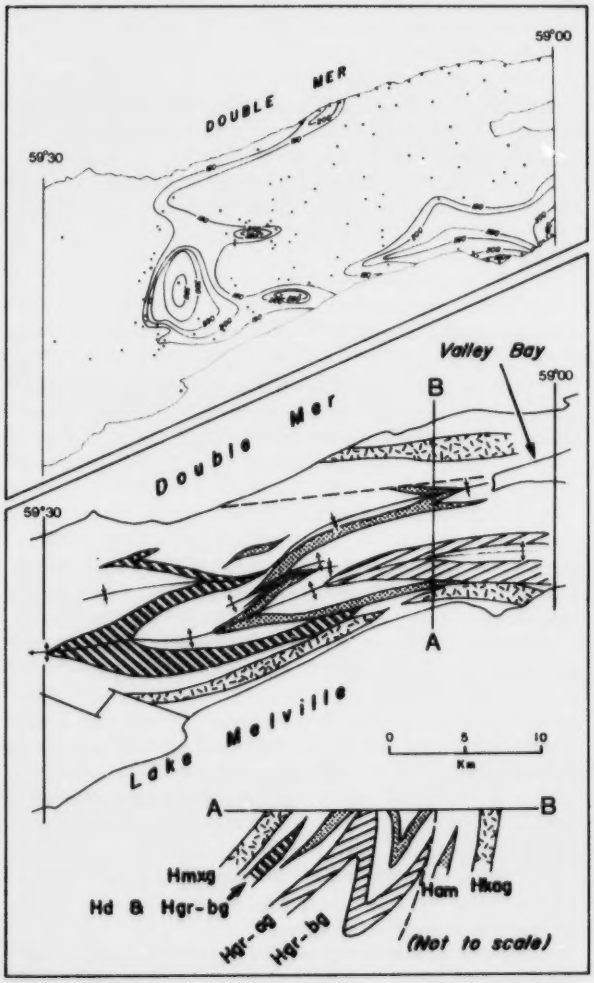


Figure 16. Alternative interpretation of the geology between Lake Melville and Double Mer (see text). Top: isorads for total counts per second of 150 and higher (see Fig. 20); bottom: generalized geological map and cross-section of the region. Units are described in Figure 1.

The granitic gneiss complex in the map area is part of the considerably larger Lake Melville terrane which extends over 100 km to the east. The complex is in thrust contact with the granodiorite gneiss complex, and is overprinted by the Lake Melville graben. A further discussion of these relations is given below.

Granodiorite gneiss complex

This tectonic assemblage incorporates mainly the gneissic rocks of units Hgd-g, Hgd-mu and Hgd-ky and granitic rocks that intrude them. Internal megascopic structures are dominated by a type 1 (dome and basin; Ramsay, 1967) fold interference pattern inferred on the map from the gently dipping foliation in unit Hgd-g. The amplitude of the upright, open antiforms and synforms is 1 km or less, and their wavelength approaches 5 km. They are most easily recognized in the western part of the region; poor exposure in the east precludes generalization to the entire gneiss terrane, but Ryan et al. (1981, 1982) have recognized this style of deformation west of the map area, which suggests that it is extensive.

The granitic plutons of units Hqmg, Hgqm, Hpxg and Hbm are inferred to have invaded the granodiorite gneiss during or after the development of the fold pattern.

Greene (1972), following Stevenson (1967), has inferred the existence of two faults across the granodiorite gneiss complex. These structures are shown to follow two nearly rectilinear valleys that converge west of Mulligan Bay. Neither the geology nor air photograph analysis provides evidence for bedrock control of the northernmost lineament, which would coincide with the Sebaskachu River, and this structure has been omitted on the present map. A portion of the other fault is reinterpreted as the trace of the thrust fault that separates the Lake Melville terrane from the granodiorite gneiss complex. The granodiorite complex is part of the Groswater Bay terrane that underlies a large area to the north of the Lake Melville terrane (Gower, 1984).

The boundary between the terranes is a shallowly east-dipping zone of intense mylonitization. This zone has a thickness of less than 1 km to more than 2 km (the apparent map width spans 3 to over 5 km), but this estimate is a minimum as only the western boundary of the zone can be interpolated on the map. The eastern (upper) strain contrast boundary is not exposed; it is inferred to have been truncated along much of its length at the present level of exposure by the northwestern bounding fault of the Lake Melville graben. As rocks of the mylonite zone are intensely deformed, they are difficult to assign to either of the adjacent terranes; however, based on the rapid but progressive increase in strain at the strain contrast boundary in the Lake Melville terrane and on the apparent lack of mylonitization of the Groswater Bay terrane, the thrust front is placed at the base (western limit of exposure) of the mylonite.

To the southwest, Wardle and Ash (1984) recognized a mylonite zone which may be a splay of the similarly gently southeast-dipping Cape Caribou River Thrust (Ryan et al., 1981, 1982). The extension of the trace of

that mylonite matches the trace of the mylonite zone in the map area, suggesting continuity of the structure and implying that regional thrusting and juxtaposition of the gneiss terranes is probably of Grenvillian age as proposed by Ryan et al. (1981, 1982). Displacement along the thrust is unknown but it is suspected to be large, possibly tens of kilometres.

Lake Melville graben

The fourth structural domain in the map area is the graben filled with strata of the Double Mer Formation, that is occupied largely by Lake Melville (Fig. 17).

The normal faults outlining the graben are not exposed. Steep rectilinear scarps bound areas of exposure of the Double Mer Formation. Double Mer strata dip moderately toward the surrounding gneiss, suggesting that the scarps mark the position of bounding faults. The gentle westerly dip of the strata in the graben is considered a structural feature (see unit descriptions). Seismic profiles (Grant, 1975) permit an estimation of the position of the southeastern bounding fault which can be traced for over 50 km; it lies beneath Lake Melville about 5 km off Etagaulet Point. An internal horst up to 5 km across is also visible on the seismic profiles (Fig. 17). It trends northeast, parallel to the graben margins.

On the basis of map patterns, the northern margin of the graben is inferred to be developed mainly in granitoid rocks of the Lake Melville terrane. The southeastern boundary lies a few kilometres north of the exposed part of the Mealy Mountains complex; it is probable that the boundary follows at least in part the contact of the anorthosite with the gneiss of the Lake Melville terrane. On this basis, strata of the Double Mer Formation in the graben, both on land and under water, are thought to be underlain by rocks of the granitic gneiss complex. Cumulative normal displacement on the faults is at least 5 km.

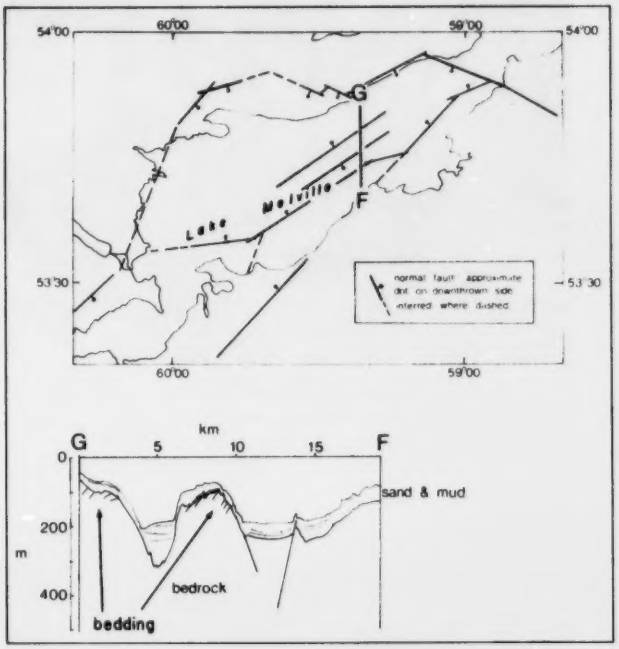


Figure 17. Top: regional extent of the Lake Melville graben system, interpreted from Grant's (1975) work and available geological data.
Bottom: tracing of seismic profiler record from Lake Melville (G-F), adapted from Grant (1975) (vertical exaggeration is about 22X). The same horst and graben structure is visible on parallel sections, to the east and west.

Minor structures

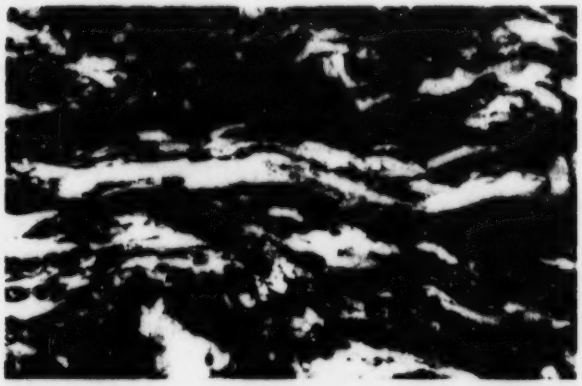
Rocks in the Mealy Mountains and in the Lake Melville graben display almost no small scale strain features. In the Mealy Mountains complex, joint sets in outcrop are parallel to the major sets visible from the air and are correlated with them. In the graben, strata of the Double Mer Formation are veined and brecciated near the contact with older rocks; epidotized and hematitized fractures occur throughout the formation. These features are considered to result from the same post-depositional deformation that tilted the beds into their present attitude.

Fabric elements

The granitic and granodioritic gneiss complexes (Lake Melville and Groswater Bay terranes) are characterized by a variety of fabrics in outcrop and in hand specimen. The dominant fabric element of strained rocks in both complexes is a marked gneissosity (segregation of minerals into layers in granoblastic rocks; units Hgr-bg, Hgr-ag, Hmd-qm, Hmd-gm and Hmd-gra), or a foliation (parallel orientation of platy minerals, mainly in orthogneiss; units Ham, Hmxg, Hkag, Hhmd, Hqmg, Hgqm, Hpxg and Hbm), or a banding (parallel orientation of layers of different composition, which may be in part transposed primary layering and in part migmatitic, mainly in paragneiss; units Hgr-gd, Hgd-ky and Hgd-mu). More than one type of fabric may exist in the same rock.

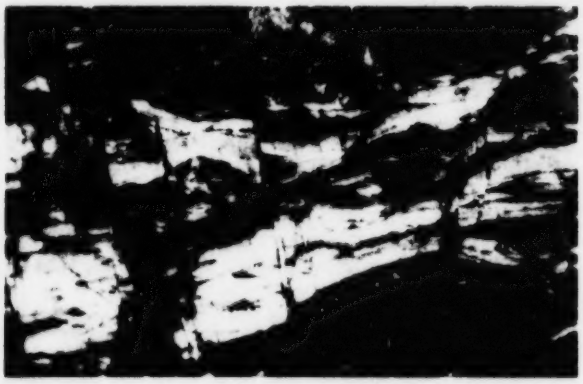
In most units, this dominant fabric is affected in outcrop by disharmonic tight to open folds ranging from 10 cm to over 10 m in amplitude. The intensity of fold development is variable; partial melting has obliterated many structures. Because of the abundance of minor structures in each outcrop, and because they do not appear to conform to any regional pattern, few detailed data on their style and attitude are presented here. Lineation attitudes reported on the map are for axes of minor folds that plunge gently to the west in the eastern part of the Lake Melville terrane, and for fine quartz or mica rodding in the mylonitic rocks surrounding the Lake Melville graben (see below).

1. Original, unstrained granitic gneiss of unit Hgr-bg. This unit is preserved in less deformed lenses throughout the zone. East-west field of view 2 cm. (GSC 204175-U)



4. Mylonite. Cataclasis has outpaced recrystallization in this rock; the wavy, ribbon quartz "flows" around resistant porphyroclasts or lensoid aggregates of fine grained, crushed material. East-west field of view 2 cm. (GSC 204175-H)

2. Plagioclase grain with subgrains, each with separate extinction. This low state of strain is an initial stage. East-west field of view 2 mm. (GSC 204175-G)



5. Brittle strain associated with the formation of the Lake Melville graben, in the form of late microfaults, overprints the mylonite. East-west field of view 2 cm. (GSC 204175-F)

3. Blastomylonite formed by concurrent cataclasis and blastesis. Dynamic recrystallization of quartz and feldspar produces the finely laminated texture seen here. East-west field of view 2 cm (compare with figure 1). (GSC 204175-K)

Figure 18. Progressive stages of development of mylonitic structure in the Sebaskachu mylonite zone. Photomicrographs in plane light.

Some of the planar fabric elements predate the formation of the dykes of unit Ham; both the dykes and the older gneiss have been overprinted and transposed during later deformation part of which was Grenvillian. The orthogneiss units (Hqmg, Hgqm, Hpxg, Hbm and Hkag) do not show a similar relationship to the dykes, i.e. they all appear to be older and pretectonic.

It is clear from the radiometric age dates of units Hgd-g and Hpxg, from the pre-dyke (pre-unit Ham) structures and from dyke deformation that the gneiss complexes are polydeformed. They first (?) underwent deformation around 1630 to 1680 Ma. This pre-Grenvillian structural-metamorphic evolution resulted in a complex set of fabrics (pre-dyke) that are overprinted relatively weakly or inhomogeneously by Grenvillian deformation. This can be established in outcrops where dykes of unit Ham are present, and is inferred for the rest of the area.

Structure of the Sebaskachu Bay mylonite zone

Rocks in the mylonite zone exhibit ductile strain of varying intensity, and overprinting brittle deformation structures associated with the Lake Melville graben (Fig. 18).

The mylonitic rocks range from augen gneiss to ultramylonite. Plagioclase, garnet and K-feldspar porphyroclasts up to 2 cm across, showing little strain, are surrounded by a mass of small (20 μm), clear, polygonal quartz grains with undulose extinction. The quartz grains range from equant, with triple junctions (foam microstructure of Kerrich and Allison, 1978), to slightly elongate, with even or, more rarely, serrated boundaries. The foliation (flow effect) is outlined by grain size variations and by elongate mineral orientation more commonly than by mineral segregation.

Serrated biotite is bent, with undulose extinction, and confined to spindle-shaped domains. The dynamic recrystallization of quartz, biotite, hornblende and other, minor phases has produced a pattern of resistant porphyroclasts surrounded by anastomosing seams of smaller grains of comminuted material.

Because of a pervasive granoblastic-polygonal texture, evidence of cataclasis is locally indistinct. Strongly deformed layers, and parts of units that lack porphyroclasts have such a simple banded structure and fine granular texture in hand specimen that they resemble comparatively undeformed metasedimentary strata. However, their mylonitic origin is indicated by rare isoclinal intrafolial folds, and by both a lattice preferred and dimension preferred orientation of quartz.

The quartz microstructures in rocks of the thrust fault zone include deformation structures (undulose extinction, deformation lamellae (bands)), recovery textures (polygonization, subgrains), and recrystallization textures (new grains, serrated grain boundaries).

Recrystallization textures are the most common, and are typical of the microstructures formed by plastic flow in many mylonites under conditions of elevated P and T (greater than 10-15 km depth, and above 250-350°C: "QP" regime of Sibson, 1977).

As outcrops showing relatively little strain occur between outcrops where deformation is high, the mylonite fabric appears to be inhomogeneously developed in the thrust fault zone.

A mineral rodding lineation is present in two localities. It plunges moderately in a south-southeast direction, suggesting major elongation and displacement parallel to that direction. Mylonite fabrics similar to those north of Sebaskachu Bay are developed in the granitic gneiss complex northeast of Lowland Point. These rocks outcrop immediately north of the scarp that bounds the highland north of Lake Melville. They are interpreted to result from movement along a ductile shear zone similar to the Sebaskachu thrust zone, which may be related to the latter, and to have been overprinted by brittle deformation during the initiation of the Lake Melville graben.

METAMORPHISM

With the exception of the Double Mer Formation, all units in the map area to the north of Lake Melville, including the mylonite, are recrystallized. A former partial melt phase, in the form of small bands or strips of quartzofeldspathic material a few centimetres across, is developed between the folia of most rocks in the gneiss complexes. Because of synkinematic recrystallization associated with metamorphism, a sugary texture characterizes many of the quartzofeldspathic layers, and igneous crystallization textures in granitoid rocks are slightly blurred rather than pristine.

To the south of Lake Melville, the Mealy Mountains complex does not show effects of metamorphism, with the exception of the monzonitic rocks (unit Hmnz), which are weakly recrystallized.

The region has undergone at least two major metamorphic events, which include early metamorphism (possibly more than one phase) accompanying the development of the pre-1680 Ma fabrics observed in the gneiss terranes, and metamorphism during the Grenvillian Orogeny.

Mineral assemblages

The effects of metamorphism in each of the rock stratigraphic assemblages (see section on structure) appear to be distinct.

In the Mealy Mountains complex, effects of metamorphism are remarkably slight. In leucotroctolite, olivine is fresh, and coexists with plagioclase, which suggests little post-crystallization reheating; no recrystallization attributable to a regional event is visible in any of the basic rocks (units Hlcn, Hlct, Hod). This is also a feature of the major anorthosite complexes of Labrador north of the Grenville Front (Emslie, 1976).

Unit Hmnz (pyroxene quartz monzonite and granite) shows weak but definite metamorphic textures. Garnet porphyroblasts are commonly associated with the clots of pyroxene and olivine; Emslie (1976) noted the

slightly recrystallized nature of grain boundaries, which he attributed to the same metamorphic event that resulted in garnet growth. This metamorphism is inferred to be of Grenvillian age.

In the Lake Melville terrane (granitic gneiss complex), most of the rocks (units Hgr-bg, Hgr-ag, Hgr-gd) contain the assemblage plagioclase-quartz-K-feldspar-biotite±hornblende, which is of high variance in any component system and has a wide field of stability. Other assemblages include:

- quartz-K-feldspar-biotite-sillimanite in diatexite (unit Hd),
- clinopyroxene-orthopyroxene-plagioclase-quartz-biotite in granulite (unit Hmd-gra),
- clinopyroxene-garnet-plagioclase-quartz-hornblende-biotite in mafic monzodiorite gneiss (unit Hmd-qm),
- hornblende-plagioclase-quartz-K-feldspar-biotite in amphibolite (unit Ham),
- quartz-K-feldspar-plagioclase-hypersthene-biotite-hornblende in granitic gneiss in the mylonite zone (unit Hgr-bg).

Sub-assemblages of these are more common than complete assemblages. These assemblages are diagnostic of the upper amphibolite and granulite facies.

The minerals are weakly strained in many places; secondary (retrograde) chlorite, biotite and muscovite are present in many rocks. Plagioclase is commonly sericitized. This suggests that the last period of metamorphism was dominantly in the greenschist facies and that it was too weak or short-lived to affect most of the higher grade assemblages.

In the granodiorite gneiss complex (Groswater Bay terrane), the assemblage plagioclase-quartz-K-feldspar-hornblende-biotite is present in most outcrops of unit Hgd-g (granodiorite gneiss). Garnet is present in a few outcrops. Scapolite occurs sparingly. Maximum-phase assemblages in other rock types include:

- quartz-K-feldspar-plagioclase-biotite in unit Hgd-mu,
- quartz-plagioclase-K-feldspar-kyanite-garnet-biotite in unit Hgd-ky (retrograde muscovite is present in rocks with these two assemblages),
- quartz-K-feldspar-plagioclase-garnet-clinopyroxene-biotite in granitic rocks of units Hqmg, Hgqm, Hpxg and Hbm,
- hornblende-clinopyroxene-garnet-plagioclase-quartz-K-feldspar in mafic gneiss of unit Hmd-gm,
- hornblende-plagioclase-garnet-orthopyroxene-biotite-K-feldspar in unit Hum.

Sub-assemblages of the above are more common than complete assemblages. These assemblages are diagnostic of the upper amphibolite facies.

Chlorite alteration of biotite, sericitization of plagioclase, and retrograde muscovite and epidote are common. These are attributed to a later metamorphism of greenschist facies.

Estimates of metamorphic conditions

The following geothermometers and geobarometers have been applied to various rocks of the region: garnet-clinopyroxene geothermometer (Ellis and Green, 1979), garnet-biotite geothermometer (Ferry and Spear, 1978), garnet-Al_2SiO_5-plagioclase-quartz geothermometer-geobarometer (Ghent, 1976), two-pyroxene geothermometer (Wells, 1977). These calculations make use of microprobe mineral analyses (Table 2)[1] obtained using the electron microprobe at Memorial University of Newfoundland (analytical procedure in Appendix C).

In addition, some of the minerals and assemblages listed in the preceding section have a relatively limited field of stability, which permits a qualitative estimate of minimum P and T conditions at the peak of metamorphism in the rocks that contain them.

Temperature results are listed in Table 3[2] and illustrated in Figure 19. Metamorphic temperatures recorded in various rock types of the Groswater Bay terrane by the geothermometers range from 496° to 875°C; this spread is attibuted to incomplete or heterogenous retrogression during the Grenvillian Orogeny. Pressure estimates for three kyanite-bearing samples (no. 3, 5, 8 in Tables 2 and 3) can be obtained by combining Ghent's (1976) expression, using the activity-composition relation for plagioclase of Newton et al. (1980) instead of Orville's (1972) activity coefficient, with the Ferry and Spear (1978) temperature results. Results are 10.3 kb (at 679°C) for sample 3, 9.5 kb (700°C) for sample 5, and 11.2 kb (730°C) for sample 8. However, Ghent's (1976) expression neglects the effects of solid solution of pyrope and spessartine in grossular; because of the uncertainty of the interaction of Mn with other atoms, Newton and Haselton (1981) have suggested that grossularite-Al_2SiO_5-albite-quartz geothermometry should be used only with garnets in which Mn = 1/3Mg or less, which is clearly not the case in samples 3, 5 and 8 where Mn is more abundant than Mg. Although the estimates appear plausible and would indicate an average peak of metamorphism at approximately 10.3 kb, they are considered invalid because of the lack of a satisfactory solid solution model for Mn-rich garnet.

However, minimum estimates of pressure can be made for the samples as they all contain kyanite. Using temperatures from the Ferry and Spear (1978) geothermometer, minimum pressure at the peak of metamorphism was 7.5 kb for sample 3, 7.8 kb for sample 5, and 8.5 kb for sample 8. This suggests a minimum average peak of metamorphism of approximately 8 kb and 700°C for the Groswater Bay terrane.

No independent quantitative estimates of pressure are available for the Lake Melville Terrane (granitic gneiss complex). Temperatures recorded by the garnet-biotite and garnet-clinopyroxene thermometers range from approximately 660° to 895°C. These estimates are largely insensitive to P variation. On the basis of the small number of samples analyzed, metamorphism in the Lake Melville terrane culminated at a higher temperature than in the Groswater Bay terrane (Fig. 19).

This conclusion confirms qualitative observations derived from mineral assemblages that suggest differing conditions of metamorphism: retrograde epidote is wide-

[1] see page 33.

[2] see page 37.

spread in the Groswater Bay terrane, but rare in the Lake Melville terrane; kyanite occurs in the Groswater Bay terrane, sillimanite in the Lake Melville terrane; sphene is present in thick mantles around ilmenite in the Groswater Bay terrane but is rare in the Lake Melville terrane.

Two-pyroxene thermometry (method of Wells, 1977, using the solid solution models of Wood and Banno, 1973), applied to a sample of leuconorite from the Mealy Mountains (unit Hlcn; sample 17 in Tables 2 and 3), and to a sample of two-pyroxene-bearing quartzofeldspathic mylonite of the Sebaskachu Bay mylonite zone (unit Hgr-bg; sample 18 in Tables 2 and 3), yields 1151° and 866°C respectively. The temperature recorded by the leuconorite is a plausible primary crystallization temperature. In the mylonite zone, the temperature is not attributed to shear heating; it is comparable to that in surrounding rocks and results from similar high grade metamorphism. As the pyroxene porphyroblasts in the mylonite are strained (i.e. pre-kinematic), the age of this metamorphism is inferred to be pre-Grenvillian. The rocks of the mylonite zone were probably brought up by thrusting from deeper levels of the Lake Melville terrane.

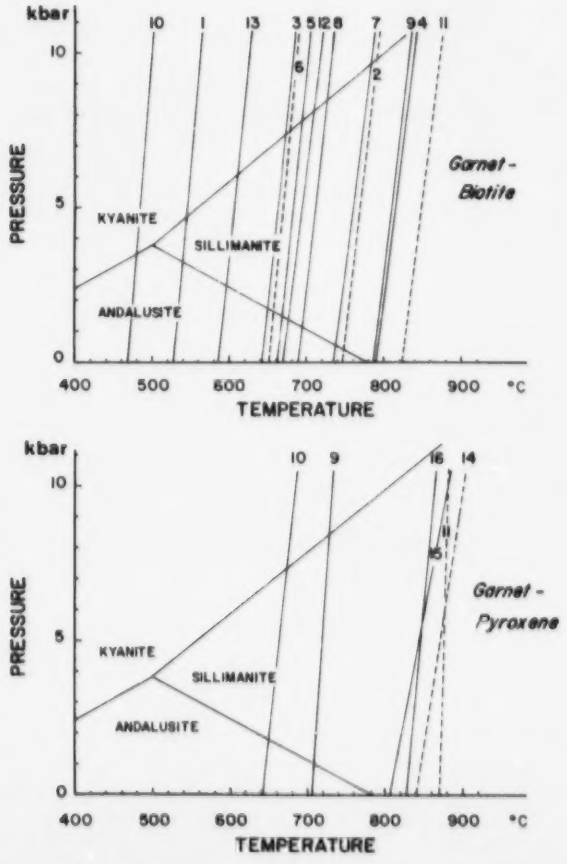


Figure 19. Results of geothermometry and geobarometry for rocks of the Groswater Bay terrane (solid curves) and of the Lake Melville terrane (dashed curves), using the garnet-biotite thermometer of Ferry and Spear (1978) and the garnet-pyroxene thermometer of Ellis and Green (1979).
Sample locatinos as in Table 3. Aluminosilicate triple point after Holdaway (1971).

ECONOMIC POTENTIAL

No new surface occurrences of economic minerals were noted during mapping. Previous exploration work in the area determined the presence of uranium mineralization, showing as yellow uranophane(?) stain on outcrop surfaces at three sites between Lake Melville and Double Mer; uraninite has been identified as the primary uranium mineral (Kerswill and McConnell, 1982). Small occurrences of ilmenite, magnetite and labradorite are reported from the Mealy Mountains.

A summary of the work carried out by mining and exploration companies in the region is given below. This information is taken from unpublished assessment reports filed with the Newfoundland Department of Mines and Energy in St. John's.

Dome Exploration Co. Ltd. explored the region north of Lake Melville in 1946 in a reconnaissance of a large part of central Labrador. British Newfoundland Corporation Ltd. prospected in the Mealy Mountains south of Lake Melville in 1954. Mokta (Canada) Ltd. completed a reconnaissance for uranium in the region north of the Mulligan River in 1965. Hudson Bay Oil and Gas Mining Ltd. carried out regional uranium exploration in 1977 in the area between Double Mer and Grand Lake. Newfoundland and Labrador Corporation Ltd. carried out several exploration programs for uranium between 1951 and 1978 in the region bordering the northeast shore of Lake Melville. As a direct follow-up of regional and local anomalies revealed by government surveys (see introduction), Northgate Exploration Ltd. carried out sampling, trenching and geochemical surveys at the uranium showings between Lake Melville and Double Mer in 1979, and geophysical surveys and about 200 m of drilling in 1980. There are no reports of exploration or assessment work in the area since 1980.

A scintillometer survey was carried out during mapping, using Scintrex GIS-4 portable scintillometers. This survey revealed that regional radioactivity peaks in the general area of known showings, in the Lake Melville terrane, north and northeast of Lowland Point. The isorad pattern interpreted from the data is given in Figure 20. This pattern is almost identical to the one obtained for uranium through regional geochemical lake sediment sampling, (Geological Survey of Canada, Open File 511, 1977), which reflects favourably on the accuracy of results derived from similar sampling in other areas of Labrador. The pattern is also in good agreement with the distribution of uranium in rock samples collected in this study; concentrations of up to 60 g/t were found in specimens from the areas outlined by the highest isorads in

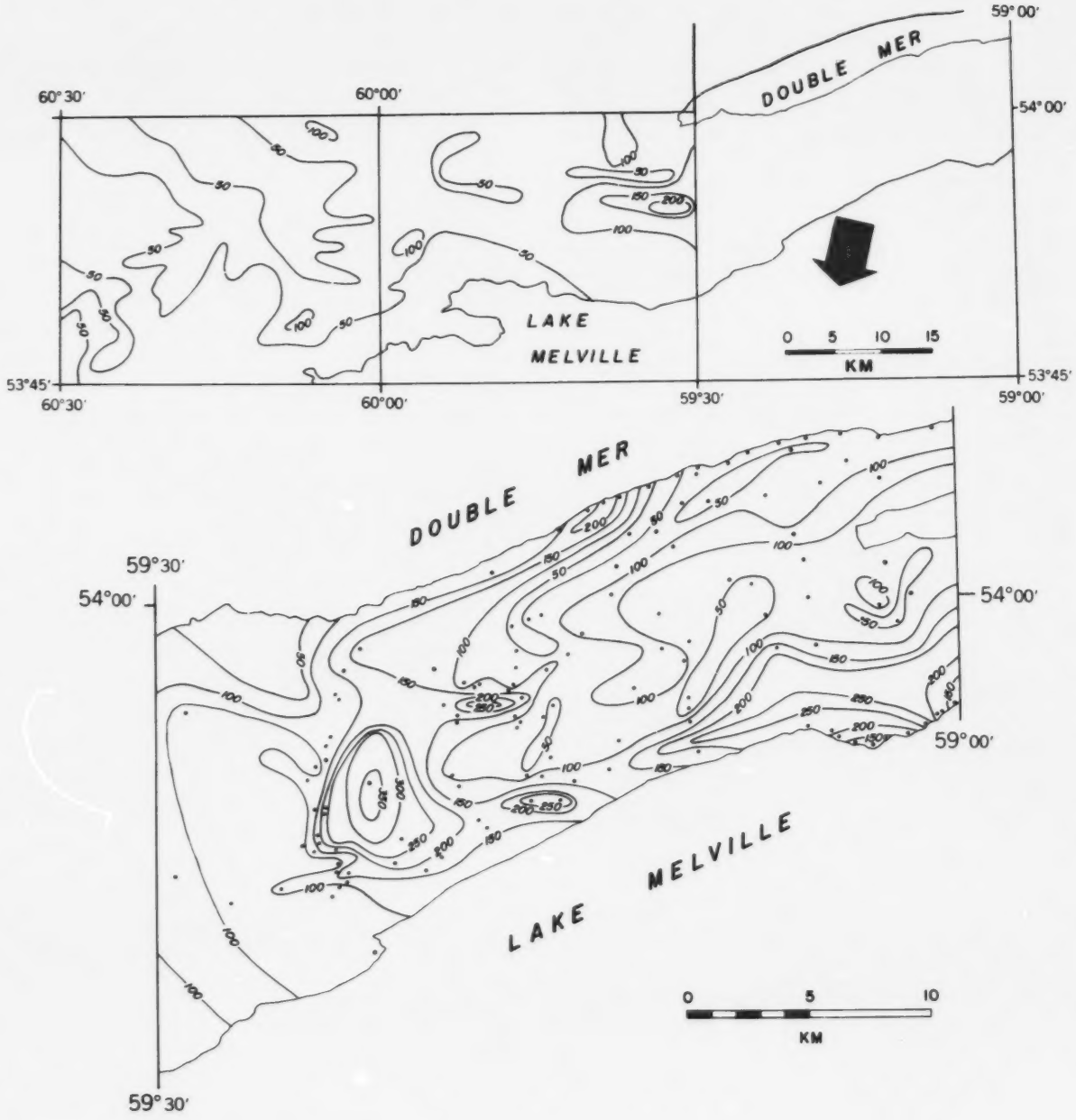


Figure 20. Radioactivity map from a scintellometer survey of the region north of Lake Melville. Isorads are in total counts per second. Dots indicate location of data stations in the region between Double Mer and Lake Melville.

Figure 20. The isorads are based on the highest measurement recorded at each station. Although higher total counts occur over a region of up to 100 km^2, the level of radioactivity is low in absolute terms (a few hundred counts per second). Where unit Hd is present, its radioactivity is invariably higher than other rock types (twice background or higher; readings of 1500 counts per second and higher were obtained from several boulders of "diatexite" in the area). This suggests that the mildly uraniferous leucocratic pegmatitic layers (unit Hd) are the major source of radioactivity, as concluded by earlier workers (e.g. Bailey, 1980). The final concentration of uranium in unit Hd is attributed to a thermal event with little accompanying deformation, most probably the Grenvillian Orogeny. If this unit is assumed to derive at least in part from metasedimentary strata (see description of rock units), all paragneiss in the region is potentially a host to uranium concentrations.

On the basis of the occurrence of unit Hd and of higher regional radioactivity, a prospective mineralization site may be located approximately 5 km northwest of the central showing, within the areas bounded by the 250 counts per second isorads on the radioactivity map.

Other minerals of economic interest are disseminated ilmenite and magnetite in most of the granitoid rocks of the region. As these minerals are common in many gneiss terranes, they do not constitute significant indicators. Occurrences of labradorite, ilmenite and magnetite in the Mealy Mountains shown in Figure 1 are taken from Douglas (1976). With the exception of metasedimentary gneiss in this and in the surrounding region (Gower and Erdmer, 1984), no particular unit appears to hold significantly more prospecting appeal than others; however, because of generally poor bedrock exposure, the intrinsic potential of the area cannot be thoroughly assessed.

GEOLOGICAL EVOLUTION OF THE REGION

From structural analysis, metamorphic mineral assemblages, and age determinations, the Grenvillian Orogeny was clearly not the principal tectonic event to affect the area. It is probable that the Grenvillian event was a dominantly thermal distrubance during which ductile deformation was not as pervasive as in earlier periods of the region's history. This observation complements growing evidence that the intensity of the Grenvillian Orogeny in northeastern Labrador may be lower or more heterogeneous than elsewhere in the structural province (Emslie, 1983), and that the bulk of deformation and metamorphism is older.

The rocks of the granodiorite and granitic gneiss complexes are among the oldest of the region. They may represent the basement to which all other rocks of the region were added, by deposition or intrusion. On the basis of the U-Pb zircon age determination of 1680 Ma for the granodiorite gneiss, these complexes are inferred to be at least of Paleohelikian age; because the strain fabric of the granodiorite gneiss is truncated by a pluton dated at 1632 Ma, parts of both gneiss complexes may be considerably older than 1680 Ma and may have had Aphebian protoliths.

These two gneiss terranes were not juxtaposed initially and they probably have differing early histories. The suite of granitoid plutons that intruded the granodiorite gneiss complex around 1632 Ma does not appear to have compositional equivalents in the granitic gneiss terrane, where the megacrystic granite bodies which are present are of different character and of uncertain age.

The Mealy Mountains anorthosite complex was emplaced into the granitic gneiss complex around 1640 Ma, and was virtually unaffected by later events.

Gabbroic and related ultramafic intrusive rocks in both gneiss terranes may belong to the same stratigraphic unit (Michael Gabbro). On this basis, they are assumed to have invaded the area about 1400 to 1500 Ma ago.

Thus, most of the geological infrastructure appears to have been in place before the Grenvillian Orogeny. The period between 1400 and 950 Ma was apparently one of relative quiescence, during which the rocks remained buried to depths of at least 25 km. The Grenvillian Orogeny appears to have been marked (1) by regional reheating (which may have been weak or heterogeneous, as older Rb-Sr ages were not reset in at least some cases) which produced retrograde mineral assemblages and concentrated uranium from older strata, and (2) by thrusting along ductile shear zones that may be reactivated older faults. The Lake Melville and Groswater Bay terranes were assembled into their final configuration during this period. Cumulative horizontal displacement along faults of this age may be considerably larger than the few kilometres implied by the contrasting metamorphism in each terrane.

Following the close of the Grenvillian event, rapid uplift to surface levels took place. This was followed by southeast-directed extension producing the northeast-trending Lake Melville graben, into which large amounts of terrigenous clastic sediments (the Double Mer Formation) were deposited. The timing of this extension is unclear; it is suspected to have occurred in the Hadrynian.

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APPENDIX A: Summary of results of radiometric dating

Sample field number	Location	Laboratory number	unit	Age (Ma)
PE82-88	53°51'N, 60°25'W	13	Hgd-g	1680
PE82-108	54°00'N, 59°56'W	12	Hpxg	1632±7

A summary of the Laboratory report to the Newfoundland Department of Mines and Energy by T. Krogh (Royal Ontario Museum) and a redrafted isotopic plot are given here. Units Hgd-g and Hpxg were given the field names "Sebaskachu tonalite gneiss" and "Double Mer Granite" respectively, and samples submitted to the ROM were similarly labelled.

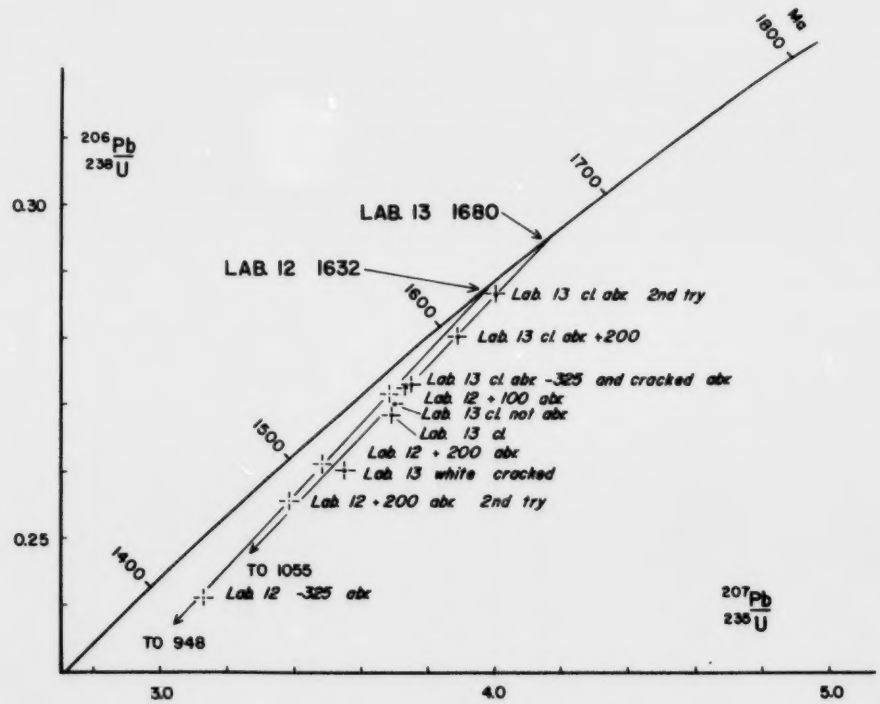
Sebaskachu tonalite gneiss & Double Mer Granite Lab 13 & Lab 12 (7 and 4 analyses)

The Sebaskachu tonalite gneiss has a euhedral zircon population of which approximately 2-5% are clear, transparent and well-faceted. They do not show metamorphic rounding like those from the Double Mer Granite either because they were not affected by this event, or because the bulk composition of the host or the metamorphic conditions did not promote resorption. With no visible metamorphic effects I did first the usual combination of clear abraded, clear, and cracked grains to get a discordia. These gave zero probability of fit and projected to 1642 (and 580 lower) Ma. Because the cracked zircon data plotted below the line, a choice of the one abraded point with the two clear fractions were regressed and gave a 3% probability of fit and an age of 1655 (and 780 lower) Ma.

This line was improved by using a new abraded hopefully higher point and two discordant points of -325 mesh abraded. The latter differed as one contained only crack-free grains, while 90% of the grains in the other were cracked. These data were combined to give a three-point line of two abraded high points and one unabraded clear, crack-free fraction. An age of 1670 (and 940) Ma was obtained. Finally, only abraded points were combined to give a 4-point line of 1680 (and 1055) Ma. Abrasion removes surface effects which occur dominantly on more discordant, cracked grains thus allowing a more precise "correct" mixing line to be obtained. The probability of fit for abraded *points* only is *96.9%*! In all other samples abrasion was done on all samples in the first place.

Double Mer Granite (Lab 12)

This sample has a highly rounded, simple igneous population indicative of metamorphic resorption. Four fractions all non-magnetic, differing only in grain size were abraded to give a line as shown. An age of 1632 ±7 Ma with a 52% probability of fit was obtained.



APPENDIX B: Locations of samples of the Double Mer sandstone that were analyzed for microfossils in the palynology laboratory of the Eastern Paleontology Section of the Institute of Sedimentary and Petroleum Geology Division of the Geological Survey of Canada in Ottawa.

General location: north shore of Lake Melville.

Field number	Latitude	Longitude
PE82-122	53°54′00″N	59°48′00″W
PE82-127	53°49′30″N	59°30′00″W
PE82-130	53°53′00″N	59°32′00″W
PE82-149	53°51′30″N	59°24′30″W
MW82-25	53°52′00″N	59°22′30″W

All samples collected by P. Erdmer field party, July 1982. All samples are barren of microfossils.

APPENDIX C: Microprobe analytical procedure.

Mineral analyses were performed by wavelength dispersive techniques using the JEOL JXA-50A electron microprobe operating at Memorial University of Newfoundland. Advice on analytical procedure was given by Henry Longerich of the Department of Earth Sciences.

The system includes three gas flow detectors and a KRISEL Control automated system. Operating conditions were:

— accelerating voltage: 15 kV
— beam current: 22×10^{-9} amp
— beam diameter approximately 1 to 3×10^{-6} m
— counting time per analysis approximately 30 seconds.

Resultant apparent concentrations of elements in the minerals analyzed (intensity ratios) were corrected for matrix effects using the method of Bence and Albee (1968). No significant zoning was detected in any of the minerals, as determined by systematic probe traverses. Mineral analyses have been averaged from counts on up to four grains per sample, with a minimum of three spot analyses on each grain.

All analyses are in weight per cent. Ionic proportions were calculated with computer programs written for each mineral. For ions other than Fe^{2+} and FE^{3+} the calculations follow the procedure outlined by Deer et al. (1966). The calculation of Fe^{3+}, and hence Fe^{2+}, follows the method of Ryburn et al. (1976); pyroxene structural formulas, for example, are first calculated to a cation total of 4 with all Fe as Fe^{2+}, and Fe^{3+} is then determined by the equation:

Fe^{3+} = (ideal cation charge)-(calculated charge)
= 4 -2Si -2Ti -Al -Cr +Na +K
(then $Fe^{2+} = Fe^{total} - Fe^{3+}$).

Table. 1 Analyses of major, minor and trace elements in rocks of the map area. The number of samples analyzed (N), the average concentration (mean), the range (minimum and maximum values; min., max.) and the standard deviation (S.D.) are given for the units of the region (with the exception of units HaPdm, Hmnz, Hod and Hlct).

Major, minor and some trace elements were analyzed by atomic absorption by staff of the Geochemistry section of the Mineral Development Division (Newfoundland Department of Mines and Energy); additional trace elements were analyzed by X-ray fluorescence by staff of the Department of Earth Sciences of Memorial University of Newfoundland (the letter "X" identifies these elements in the table).

The CIPW norm and differentiation index (Thornton and Tuttle, 1960) are given for the metaplutonic units. These were calculated using programs of the Computer unit of the Mineral Development Division; mineral abbreviations: qz= quartz, co= corundum, or= orthoclase, ab= albite, an= anorthite, di= diopside, hy= hypersthene, mt= magnetite, il= ilmenite, ap= apatite, ol= olivine.

Elements for which the analytical detection limit was greater than the concentration present in some samples have a lower "N" (number of analyses) than the rest of the elements in the unit (i.e. only "trace" amounts of the element were reported, and were not considered in the statistics).

The chemical composition spans a wide range for each map unit, and reported minimum and maximum concentrations of individual elements almost invariably lie well outside the accepted compositional limits for each rock type.

A selection of analyses of the two purest rocks (based on external appearance) of each unit results in little decrease in the compositional spread in most cases. This large cryptic variability within rock units was the reason for considering the mean composition of all samples analyzed (including other minor rock types in some cases) in an attempt to minimize the effect of sample variability.

The rock type corresponding to this mean composition in granitoid units commonly matches that suggested by estimates of modal composition from most of the stained slabs of rocks assigned to the unit.

However, it should be noted that the heterogeneity of these polyorogenic rocks may be so great that an attempt to quantify entire units may be inappropriate, and comparisons with rocks in other regions should be made with caution.

Unit Hd — Diatexite or pegmatite

Wt. %	N	Range mean	min.	max.	S.D.	CIPW	norm
SiO_2	13	72.31	61.50	83.10	5.70	qz	29.8
Al_2O_3	13	13.69	8.85	18.25	2.53	co	0.8
Fe_2O_3	13	0.48	0.01	1.28	0.45	or	33.0
FeO	13	1.20	0.00	4.31	1.17	ab	27.1
MgO	13	0.53	0.01	2.92	0.75	an	4.9
CaO	13	1.07	0.36	2.77	0.62	hy	2.8
Na_2O	13	3.15	2.23	4.23	0.63	mt	0.7
K_2O	13	5.50	2.77	8.57	1.74	il	0.4
TiO_2	13	0.24	0.02	0.67	0.19	ap	0.1
MnO	13	0.04	0.01	0.10	0.03		
P_2O_5	13	0.07	0.01	0.27	0.07		
L.O.I.	13	0.68	0.36	0.97	0.19		
CALCTOT	13	98.97				total	99.5
PPM						DI= 89.5	
Cu	13	5.31	1.00	10.00	2.81		
Zn	13	31.46	4.00	97.00	24.15		
Pb	13	26.85	13.00	43.00	9.68		
Ni	13	4.77	1.00	33.00	8.70		
Li	13	15.15	3.00	48.00	11.16		
Mo	13	3.46	2.00	8.00	1.51		
U	13	5.45	0.70	17.00	4.79		
F	13	376.08	11.00	3004.00	797.39		
BaX	13	541.69	214.00	1225.00	301.14		
SrX	13	112.85	49.00	220.00	59.29		
RbX	13	225.15	111.00	360.00	68.73		
CrX	13	9.00	5.00	57.00	14.42		
VX	13	20.08	5.00	106.00	28.64		
NbX	13	11.69	2.00	24.00	7.34		
ZrX	13	132.69	4.00	353.00	114.63		
YX	13	40.85	3.00	209.00	52.51		
ThX	13	15.92	1.00	39.00	14.21		
GaX	13	15.77	10.00	23.00	3.24		
CeX	13	40.85	5.00	99.00	24.54		
LaX	13	18.38	1.00	49.00	13.94		

Unit Hum — 1: hornblendite, 2: peridotite

Wt. %	sample 1	CIPW	norm	sample 2	CIPW	norm
SiO_2	48.50	or	3.4	38.30	or	0.6
Al_2O_3	12.25	ab	17.8	1.52	ab	1.1
Fe_2O_3	3.64	an	23.4	7.25	an	3.9
FeO	7.26	di	19.1	5.18	di	22.5
MgO	13.14	hy	19.2	31.73	hy	11.5
CaO	9.39	mt	5.4	6.02	mt	11.6
Na_2O	1.98	il	0.9	0.12	il	0.4
K_2O	0.57	ap	0.1	0.01	ol	48.6
TiO_2	0.50	ol	10.9	0.21		
MnO	0.22			0.21		
P_2O_5	0.05			0.03		
L.O.I.	1.38			8.62		
CALCTOT	98.87	total	100.2	99.21	total	100.2
PPM		DI= 20.6		*PPM*	DI= 11.2	
Cu	20.00			9.00		
Zn	87.00			110.00		
Pb	1.00					
Ni	207.00			844.00		
Mo	3.00			3.00		
U	0.50			0.10		
F	77.00			39.00		
BaX	369.00			30.00		
SrX	878.00			44.00		
RbX	13.00			4.00		
CrX	863.00			2569.00		
VX	201.00			50.00		
NbX	3.00			1.00		
ZrX	24.00			11.00		
YX	11.00			6.00		
ThX	1.00			4.00		
GaX	10.00			3.00		
CeX	8.00			5.00		
LaX	10.00			5.00		

Unit Hga — Gabbro

Wt. %	N	mean	CIPW	norm
SiO_2	1	49.40	or	5.5
Al_2O_3	1	17.05	ab	18.7
Fe_2O_3	1	1.16	an	34.4
FeO	1	7.28	di	17.1
MgO	1	8.63	hy	9.7
CaO	1	11.14	mt	1.7
Na_2O	1	2.18	il	1.1
K_2O	1	0.93	ol	11.3
TiO_2	1	0.60	ap	0.1
MnO	1	0.15		
P_2O_5	1	0.07		
L.O.I.	1	1.27		
CALCTOT	1	99.86	total	99.6
PPM			DI= 24.2	
Cu	1	45.00		
Zn	1	28.00		
Ni	1	45.00		
Li	1	19.00		
Mo	1	3.00		
U	1	0.60		
F	1	184.00		
BaX	1	160.00		
SrX	1	122.00		
RbX	1	34.00		
CrX	1	414.00		
VX	1	232.00		
NbX	1	4.00		
ZrX	1	53.00		
YX	1	31.00		
ThX	1	6.00		
GaX	1	12.00		
CeX	1	13.00		
LaX	1	10.00		

Unit Hgqm — Hornblende granite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	6	68.55	64.50	71.70	2.39	qz	17.3
Al_2O_3	6	14.71	12.25	17.45	1.65	or	36.7
Fe_2O_3	6	1.30	0.78	2.66	0.69	ab	36.0
FeO	6	2.12	1.54	2.63	0.40	an	3.0
MgO	6	0.28	0.12	0.37	0.09	di	1.7
CaO	6	1.14	0.78	1.33	0.20	hy	2.1
Na_2O	6	4.22	3.65	5.12	0.49	mt	1.9
K_2O	6	6.16	5.43	6.53	0.42	il	0.7
TiO_2	6	0.41	0.22	0.53	0.11	ap	0.2
MnO	6	0.10	0.07	0.13	0.02		
P_2O_5	6	0.09	0.05	0.13	0.03		
L.O.I.	6	0.29	0.23	0.38	0.05		
CALCTOT	6	99.37				total	99.6
PPM						DI= 99.6	
Cu	6	4.83	3.00	7.00	1.47		
Zn	6	115.83	82.00	163.00	27.74		
Pb	6	23.00	20.00	27.00	2.53		
Ni	0						
Li	6	10.33	3.00	20.00	5.68		
Mo	6	4.00	3.00	5.00	0.89		
U	6	0.95	0.80	1.10	0.14		
F	6	306.17	164.00	555.00	137.12		
BaX	6	960.50	194.00	1218.00	383.33		
SrX	6	174.83	19.00	283.00	85.66		
RbX	6	174.83	19.00	283.00	85.66		
CrX	6	5.00	5.00	5.00	0.00		
VX	6	5.00	5.00	5.00	0.00		
NbX	6	31.50	14.00	64.00	20.71		
ZrX	6	429.50	246.00	638.00	131.51		
YX	6	68.83	56.00	96.00	20.95		
ThX	6	5.83	1.00	10.00	3.87		
GaX	6	22.17	16.00	32.00	5.88		
CeX	6	116.67	93.00	159.00	23.77		
LaX	6	61.33	42.00	83.00	16.77		

Unit Hqmg — Biotite quartz monzonite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	3	64.43	64.10	64.80	0.35	qz	11.6
Al_2O_3	3	15.30	15.10	15.65	0.30	or	32.3
Fe_2O_3	3	1.65	1.48	1.76	0.15	ab	38.4
FeO	3	3.53	3.34	3.79	0.23	an	5.6
MgO	3	0.80	0.70	0.86	0.09	di	2.0
CaO	3	2.07	1.94	2.17	0.12	hy	5.0
Na_2O	3	4.50	4.30	4.84	0.29	mt	2.0
K_2O	3	5.42	5.23	5.69	0.24	il	1.6
TiO_2	3	0.88	0.84	0.91	0.04	ap	0.8
MnO	3	0.19	0.17	0.21	0.02		
P_2O_5	3	0.35	0.34	0.37	0.02		
L.O.I.	3	0.36	0.26	0.47	0.11		
CALCTOT	3	99.49				total	99.7
PPM						DI= 82.5	
Cu	3	6.00	3.00	8.00	2.65		
Zn	3	151.67	143.00	164.00	10.97		
Pb	3	21.67	19.00	23.00	2.31		
Ni	1	1.00	1.00	1.00			
Li	3	12.33	12.00	13.00	0.58		
Mo	3	3.33	2.00	5.00	1.53		
U	3	1.07	0.50	1.40	0.49		
F	3	686.33	260.00	925.00	370.10		
BaX	3	2261.33	2073.00	2511.00	225.35		
SrX	3	262.33	253.00	271.00	9.02		
RbX	3	104.33	72.00	123.00	28.11		
CrX	3	5.00	5.00	5.00	0.00		
VX	3	9.00	5.00	11.00	3.46		
NbX	3	28.00	22.00	32.00	5.29		
ZrX	3	319.67	255.00	372.00	59.47		
YX	3	83.00	63.00	94.00	17.35		
ThX	3	3.67	1.00	8.00	3.79		
GaX	3	20.33	19.00	21.00	1.15		
CeX	3	97.00	70.00	120.00	25.24		
LaX	3	50.00	40.00	62.00	11.14		

Unit Hpxg — Pyroxene granite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	18	67.98	59.20	75.60	3.86	qz	18.9
Al_2O_3	18	15.01	12.60	17.05	1.14	or	31.4
Fe_2O_3	18	1.08	0.13	2.18	0.57	ab	35.3
FeO	18	2.15	0.87	4.96	0.99	an	6.9
MgO	18	0.75	0.25	2.07	0.55	hy	4.3
CaO	18	1.63	0.85	2.93	0.60	mt	1.5
Na_2O	18	4.13	3.46	4.84	0.49	il	1.0
K_2O	18	5.25	3.48	6.62	0.88	ap	0.4
TiO_2	18	0.52	0.16	1.38	0.28		
MnO	18	0.11	0.05	0.24	0.05		
P_2O_5	18	0.19	0.03	0.60	0.14		
L.O.I.	18	0.60	0.16	1.57	0.39		
CALCTOT	18	99.40				total	99.7
PPM						DI= 85.6	
Cu	18	8.06	2.00	18.00	4.17		
Zn	18	89.89	33.00	180.00	40.27		
Pb	18	23.67	14.00	60.00	9.88		
Ni	10	5.40	1.00	22.00	7.81		
Li	18	14.00	5.00	23.00	5.22		
Mo	18	3.67	3.00	5.00	0.59		
U	18	0.99	0.50	1.80	0.31		
F	18	428.17	98.00	874.90	206.54		
BaX	18	1587.94	431.00	3246.00	769.79		
SrX	18	339.67	55.00	893.00	240.05		
RbX	18	101.89	68.00	153.00	26.63		
CrX	18	7.17	5.00	33.00	6.95		
VX	18	18.72	4.00	69.00	21.42		
NbX	18	16.67	7.00	25.00	5.92		
ZrX	18	289.78	93.00	587.00	141.12		
YX	18	52.44	14.00	96.00	25.50		
ThX	18	3.28	1.00	12.00	3.39		
GaX	18	18.94	16.00	26.00	2.92		
CeX	18	66.89	24.00	135.00	32.81		
LaX	18	33.22	5.00	75.00	17.03		

Unit Hbm — Biotite monzodiorite

Wt. %	N	mean	CIPW	norm
SiO_2	1	46.50	or	13.2
Al_2O_3	1	13.50	ab	31.1
Fe_2O_3	1	4.61	an	14.3
FeO	1	10.87	di	10.3
MgO	1	4.74	hy	3.0
CaO	1	7.47	mt	6.7
Na_2O	1	3.62	il	5.8
K_2O	1	2.20	ap	3.9
TiO_2	1	3.05	ol	11.4
MnO	1	0.23		
P_2O_5	1	1.63		
L.O.I.	1	9.31		
CALCTOT	1	98.73	total	99.7
PPM			DI= 44.3	
Cu	1	28.00		
Zn	1	208.00		
Pb	1	1.00		
Ni	1	22.00		
Li	1	21.00		
Mo	1	6.00		
U	1	0.70		
F	1	1483.00		
BaX	1	764.00		
SrX	1	408.00		
RbX	1	54.00		
CrX	1	5.00		
VX	1	256.00		
NbX	1	32.00		
ZrX	1	238.00		
YX	1	74.00		
ThX	1	1.00		
GaX	1	31.00		
CeX	1	103.00		
LaX	1	40.00		

Unit Hhmd — Leucomonzodiorite

Wt. %	N	mean	CIPW	norm
SiO_2	1	53.90	qz	1.1
Al_2O_3	1	20.35	or	7.6
Fe_2O_3	1	1.79	ab	44.5
FeO	1	4.65	an	29.3
MgO	1	2.06	di	0.9
CaO	1	6.68	hy	9.9
Na_2O	1	5.15	mt	2.2
K_2O	1	1.26	il	2.6
TiO_2	1	1.38	ap	1.2
MnO	1	0.12		
P_2O_5	1	0.51		
L.O.I.	1	0.42		
CALCTOT	1	98.27	total	99.3
PPM			DI= 53.3	
Cu	1	22.00		
Zn	1	101.00		
Pb	1	7.00		
Ni	1	9.00		
Li	1	13.00		
Mo	1	4.00		
U	1	0.80		
F	1	696.00		
BaX	1	553.00		
SrX	1	722.00		
RbX	1	8.00		
CrX	1	5.00		
VX	1	76.00		
NbX	1	28.00		
ZrX	1	327.00		
YX	1	34.00		
ThX	1	1.00		
GaX	1	26.00		
CeX	1	49.00		
LaX	1	24.00		

Unit Hlcn — Leuconorite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	3	50.40	42.30	54.80	7.02	qz	1.2
Al_2O_3	3	21.73	15.25	25.15	5.62	or	8.8
Fe_2O_3	3	3.35	0.66	6.35	2.86	ab	35.8
FeO	3	3.29	0.00	9.09	5.04	an	37.1
MgO	3	2.09	0.83	4.30	1.92	di	2.4
CaO	3	8.69	7.18	9.54	1.31	hy	4.5
Na_2O	3	4.14	3.00	4.83	0.99	mt	4.9
K_2O	3	1.47	1.10	1.93	0.42	il	3.7
TiO_2	3	1.94	0.22	4.56	2.31	ap	1.3
MnO	3	0.16	0.04	0.40	0.21		
P_2O_5	3	0.56	0.09	1.42	0.74		
L.O.I.	3	1.57	0.43	3.12	1.39		
CALCTOT	3	99.40				total	99.7
PPM						DI= 45.7	
Cu	3	49.33	9.00	70.00	34.93		
Zn	3	68.67	25.00	151.00	71.35		
Pb	3	42.67	1.00	126.00	72.17		
Ni	3	37.33	10.00	76.00	34.43		
Li	3	8.00	6.00	9.00	1.73		
Mo	3	5.00	4.00	6.00	1.00		
U	3	0.70	0.10	1.80	0.95		
F	3	492.00	101.00	1255.00	660.85		
BaX	3	754.33	582.00	919.00	168.63		
SrX	3	555.00	271.00	703.00	246.02		
RbX	3	23.00	6.00	56.00	28.58		
CrX	3	5.00	5.00	5.00	0.00		
VX	3	68.67	15.00	166.00	84.44		
NbX	3	18.33	2.00	49.00	26.58		
ZrX	3	156.33	12.00	434.00	240.53		
YX	3	27.33	3.00	74.00	40.43		
ThX	3	1.67	1.00	3.00	1.15		
GaX	3	19.00	18.00	20.00	1.00		
CeX	3	43.67	11.00	105.00	53.15		
LaX	3	18.67	5.00	46.00	23.67		

Unit Hmxg — Biotite and horneblende granite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	6	71.20	69.80	72.40	1.12	qz	28.4
Al_2O_3	6	13.13	12.85	13.55	0.24	co	0.1
Fe_2O_3	6	1.14	0.66	1.98	0.46	or	35.9
FeO	6	1.86	1.30	3.37	0.76	ab	24.7
MgO	6	0.46	0.28	0.65	0.15	an	4.9
CaO	6	1.07	0.09	1.53	0.23	hy	3.0
Na_2O	6	2.88	2.60	3.05	0.17	mt	1.6
K_2O	6	5.98	5.33	6.39	0.38	il	0.8
TiO_2	6	0.43	0.34	0.57	0.09	ap	0.1
MnO	6	0.06	0.04	0.10	0.02		
P_2O_5	6	0.07	0.04	0.10	0.02		
L.O.I.	6	0.79	0.55	0.96	0.17		
CALCTOT	6	99.07				total	99.5
PPM						DI= 89.1	
Cu	6	6.50	4.00	8.00	1.76		
Zn	6	61.83	38.00	112.00	26.24		
Pb	6	29.33	26.00	34.00	3.27		
Ni	6	1.50	1.00	2.00	0.55		
Li	6	17.33	8.00	38.00	11.27		
Mo	6	4.17	3.00	5.00	0.75		
U	6	6.67	3.70	9.50	1.84		
F	6	596.00	441.00	1028.00	221.24		
BaX	6	553.83	343.00	713.00	135.93		
SrX	6	59.67	46.00	84.00	13.19		
RbX	6	285.00	251.00	321.00	23.09		
CrX	6	5.00	5.00	5.00	0.00		
VX	6	14.17	50.00	21.00	5.95		
NbX	6	23.67	17.00	35.00	6.06		
ZrX	6	347.33	273.00	532.00	96.07		
YX	6	86.67	54.00	137.00	28.10		
ThX	6	31.17	22.00	43.00	7.94		
GaX	6	16.83	15.00	19.00	1.33		
CeX	6	72.67	50.00	89.00	13.60		
LaX	6	34.00	18.00	40.00	8.20		

Unit Hkag — Biotite granite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	5	67.58	65.50	69.40	1.57	qz	24.1
Al_2O_3	5	15.03	14.60	15.30	0.27	co	1.0
Fe_2O_3	5	1.54	1.38	1.77	0.15	or	28.4
FeO	5	2.36	2.04	2.72	0.27	ab	26.8
MgO	5	1.26	1.11	1.46	0.16	an	10.3
CaO	5	2.25	1.99	2.70	0.29	hy	5.4
Na_2O	5	3.13	2.93	3.23	0.13	mt	2.2
K_2O	5	4.76	4.63	4.96	0.15	il	1.1
TiO_2	5	0.60	0.53	0.70	0.07	ap	0.3
MnO	5	0.09	0.08	0.11	0.01		
P_2O_5	5	0.15	0.13	0.17	0.02		
L.O.I.	5	0.90	0.61	1.26	0.26		
CALCTOT	5	99.65				total	99.6
PPM						DI= 79.4	
Cu	5	29.40	18.00	54.00	14.36		
Zn	5	63.00	57.00	67.00	4.69		
Pb	5	20.40	17.00	28.00	4.39		
Ni	5	10.60	9.00	13.00	1.52		
Li	5	20.60	18.00	22.00	1.95		
Mo	5	2.60	2.00	3.00	0.55		
U	5	3.04	1.20	6.50	2.07		
F	5	804.80	708.00	899.00	85.15		
BaX	5	935.00	778.00	1080.00	133.72		
SrX	5	209.40	172.00	232.00	26.32		
RbX	5	176.40	159.00	188.00	11.55		
CrX	5	5.00	5.00	5.00	0.00		
VX	5	61.20	54.00	75.00	8.64		
NbX	5	17.60	16.00	19.00	1.14		
ZrX	5	198.20	182.00	224.00	18.01		
YX	5	45.80	41.00	54.00	5.07		
ThX	5	12.20	9.00	17.00	3.11		
GaX	5	16.20	15.00	17.00	0.84		
CeX	5	43.80	37.00	53.00	6.30		
LaX	5	22.20	17.00	33.00	6.46		

Unit Hmd-gm — Hornblende monzodiorite gneiss

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	10	49.73	41.30	69.50	7.70	or	9.0
Al_2O_3	10	17.05	8.50	23.40	4.95	ab	23.0
Fe_2O_3	10	3.48	0.41	5.97	1.52	an	30.0
FeO	10	6.19	0.98	10.11	2.55	di	17.4
MgO	10	6.02	0.40	12.62	3.54	hy	8.5
CaO	10	10.54	2.23	14.67	3.83	mt	5.1
Na_2O	10	2.68	1.29	4.83	1.17	il	1.4
K_2O	10	1.51	0.76	3.27	0.81	ap	0.3
TiO_2	10	0.75	0.18	1.15	0.31	ol	4.2
MnO	10	0.15	0.07	0.21	0.05		
P_2O_5	10	0.16	0.05	0.45	0.13		
L.O.I.	10	0.81	0.38	1.41	0.32		
CALCTOT	10	99.07				total	98.9
PPM						DI= 57.9	
Cu	10	168.00	9.00	835.00	255.91		
Zn	10	81.40	42.00	116.00	25.79		
Pb	10	4.57	1.00	17.00	5.77		
Ni	10	18.50	1.00	65.00	19.77		
Li	10	15.00	9.00	20.00	3.27		
Mo	10	4.60	3.00	6.00	0.84		
U	10	0.53	0.30	0.90	0.19		
F	10	528.80	32.00	874.00	254.04		
BaX	10	734.80	235.00	2486.00	706.24		
SrX	10	805.00	183.00	1684.00	467.37		
RbX	10	26.70	8.00	58.00	20.85		
CrX	10	67.90	5.00	361.00	132.49		
VX	10	317.70	10.00	800.00	203.43		
NbX	10	4.40	2.00	7.00	1.58		
ZrX	10	57.00	22.00	126.00	29.17		
YX	10	17.30	6.00	27.00	7.54		
ThX	10	1.00	1.00	1.00	0.00		
GaX	10	19.30	10.00	29.00	5.01		
CeX	10	21.30	12.00	37.00	8.38		
LaX	10	11.60	5.00	19.00	4.25		

Unit Hmd-qm — Quartz monzodiorite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	31	59.05	44.20	71.10	7.80	qz	10.9
Al_2O_3	31	15.67	12.95	18.75	1.47	or	15.6
Fe_2O_3	31	2.37	0.10	6.69	1.56	ab	31.3
FeO	31	4.54	1.05	10.10	2.56	an	19.0
MgO	31	3.49	0.40	8.35	2.09	di	5.8
CaO	31	5.54	1.13	10.57	2.66	hy	11.1
Na_2O	31	3.64	2.28	5.31	0.84	mt	3.5
K_2O	31	2.60	0.63	6.66	1.58	il	1.8
TiO_2	31	0.95	0.17	2.79	0.55	ap	0.6
MnO	31	0.13	0.04	0.25	0.06		
P_2O_5	31	0.25	0.03	1.70	0.29		
L.O.I.	31	1.18	0.54	2.88	0.67		
CALCTOT	31	99.41				total	99.6
PPM						DI= 57.9	
Cu	31	30.03	3.00	84.00	24.26		
Zn	31	81.06	21.00	159.00	30.24		
Pb	27	10.33	1.00	23.00	6.60		
Ni	30	30.10	2.00	100.00	26.57		
Li	31	12.45	2.00	35.00	7.59		
Mo	31	3.71	2.00	6.00	0.78		
U	31	1.28	0.10	5.70	1.38		
F	31	587.19	179.00	1880.00	386.32		
BaX	31	852.10	100.00	3428.00	694.93		
SrX	31	472.16	64.00	1498.00	398.38		
RbX	31	71.48	12.00	203.00	46.81		
CrX	31	44.84	5.00	237.00	65.50		
VX	31	144.13	16.00	433.00	99.75		
NbX	31	13.19	1.00	49.00	10.19		
ZrX	31	210.84	18.00	623.00	144.99		
YX	31	45.94	5.00	105.00	24.77		
ThX	31	3.16	1.00	33.00	6.50		
GaX	31	18.55	13.00	25.00	3.47		
CeX	31	37.87	20.00	106.00	16.92		
LaX	31	18.68	5.00	50.00	8.56		

Unit Hmd-gra — Granulite gneiss

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	2	50.65	50.60	50.70	0.07	qz	0.1
Al_2O_3	2	15.42	14.80	16.05	0.88	or	8.2
Fe_2O_3	2	3.66	1.29	6.03	3.35	ab	24.4
FeO	2	8.30	7.97	8.64	0.47	an	25.2
MgO	2	6.07	5.15	6.99	1.30	di	15.4
CaO	2	9.09	8.71	9.48	0.54	hy	17.8
Na_2O	2	2.87	2.68	3.06	0.27	mt	5.3
K_2O	2	1.38	0.89	1.87	0.69	il	2.9
TiO_2	2	1.52	1.02	2.02	0.71	ap	0.4
MnO	2	0.22	0.18	0.27	0.06		
P_2O_5	2	0.18	0.09	0.27	0.13		
L.O.I.	2	0.35	0.15	0.55	0.28		
CALCTOT	2	99.73				total	99.7
PPM						DI= 32.7	
Cu	2	38.00	10.00	66.00	39.60		
Zn	2	115.00	91.00	139.00	33.94		
Pb	2	2.00	1.00	3.00	1.41		
Ni	2	57.50	40.00	75.00	24.75		
Li	2	19.00	11.00	27.00	11.31		
Mo	2	3.50	3.00	4.00	0.71		
U	2	0.40	0.40	0.40	0.00		
F	2	809.00	505.00	1113.00	429.92		
BaX	2	405.50	369.00	442.00	51.62		
SrX	2	159.00	146.00	172.00	18.38		
RbX	2	67.00	26.00	108.00	57.98		
CrX	2	117.50	57.00	178.00	85.56		
VX	2	262.50	220.00	305.00	60.10		
NbX	2	8.00	7.00	9.00	1.41		
ZrX	2	149.00	102.00	196.00	66.47		
YX	2	53.50	43.00	64.00	14.85		
ThX	2	1.00	1.00	1.00	0.00		
GaX	2	16.00	13.00	19.00	4.24		
CeX	2	36.00	28.00	44.00	11.31		
LaX	2	18.50	16.00	21.00	3.54		

Unit Ham — Amphibolite

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	33	54.38	44.00	76.50	10.39	qz	6.7
Al_2O_3	33	14.46	10.70	18.45	1.55	or	14.3
Fe_2O_3	33	3.31	0.05	10.20	1.99	ab	24.9
FeO	33	7.08	0.31	12.92	3.71	an	19.9
MgO	33	4.83	0.11	9.92	2.73	di	10.1
CaO	33	6.63	0.75	10.95	3.24	hy	15.5
Na_2O	33	2.88	1.54	4.27	0.71	mt	4.9
K_2O	33	2.38	0.70	6.61	1.47	il	2.9
TiO_2	33	1.53	0.07	3.17	0.86	ap	0.4
MnO	33	0.19	0.01	0.30	0.09		
P_2O_5	33	0.18	0.01	0.39	0.10		
L.O.I.	33	1.40	0.50	3.41	0.81		
CALCTOT	33	99.26				total	99.6
PPM						DI= 45.9	
Cu	33	53.79	2.00	219.00	50.30		
Zn	33	101.94	10.00	169.00	40.88		
Pb	26	10.15	1.00	41.00	11.79		
Ni	32	51.38	2.00	221.00	44.64		
Li	33	23.88	8.00	52.00	10.69		
Mo	33	3.97	3.00	6.00	0.81		
U	33	3.49	0.30	37.70	6.79		
F	33	805.27	0.00	3338.00	638.81		
BaX	33	448.33	146.00	1498.00	327.97		
SrX	33	133.55	46.00	210.00	42.29		
RbX	33	111.09	27.00	252.00	61.66		
CrX	33	72.88	5.00	245.00	66.72		
VX	33	246.55	5.00	518.00	139.61		
NbX	33	16.36	2.00	99.00	18.30		
ZrX	33	171.00	43.00	348.00	80.75		
YX	33	49.67	23.00	98.00	16.62		
ThX	33	6.42	1.00	34.00	8.64		
GaX	33	17.18	12.00	23.00	2.94		
CeX	33	38.06	8.00	66.00	15.82		
LaX	33	18.67	5.00	34.00	7.54		

Unit Hgd-mu — Muscovite gneiss

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	15	67.29	47.80	75.60	7.44	qz	21.6
Al_2O_3	15	15.65	12.20	20.50	2.29	co	1.2
Fe_2O_3	15	0.97	0.23	1.95	0.62	or	21.6
FeO	15	1.91	0.52	7.34	1.78	ab	35.7
MgO	15	1.50	0.10	9.44	2.31	an	9.9
CaO	15	2.80	0.24	11.58	2.79	hy	6.1
Na_2O	15	4.18	2.44	5.57	0.87	mt	1.4
K_2O	15	3.68	0.25	5.77	1.44	il	0.6
TiO_2	15	0.32	0.10	0.67	0.19	ap	1.5
MnO	15	0.08	0.03	0.16	0.04		
P_2O_5	15	0.12	0.01	0.31	0.10		
L.O.I.	15	0.63	0.30	1.43	0.27		
CALCTOT	15	99.13				total	99.6
PPM						DI= 79.0	
Cu	15	18.00	2.00	65.00	18.32		
Zn	15	62.07	24.00	142.00	36.01		
Pb	15	17.00	1.00	46.00	10.27		
Ni	13	15.77	1.00	143.00	38.97		
Li	15	13.67	2.00	30.00	6.68		
Mo	15	3.33	2.00	5.00	0.72		
U	15	1.09	0.10	2.60	0.74		
F	15	312.40	16.00	1284.00	343.71		
BaX	15	1335.93	112.00	3181.00	722.71		
SrX	15	649.27	26.00	1490.00	419.82		
RbX	15	79.73	5.00	147.00	35.19		
CrX	15	7.40	5.00	41.00	9.30		
VX	15	30.40	5.00	108.00	29.17		
NbX	15	9.40	1.00	26.00	6.68		
ZrX	15	127.40	20.00	290.00	62.57		
YX	15	20.80	2.00	81.00	19.42		
ThX	15	3.47	1.00	17.00	4.91		
GaX	15	17.93	12.00	24.00	4.04		
CeX	15	34.80	13.00	62.00	15.99		
LaX	15	16.00	5.00	29.00	8.33		

Unit Hgd-g — Granodiorite gneiss

Wt. %	N	mean	Range min.	Range max.	S.D.	CIPW	norm
SiO_2	67	66.68	51.90	94.00	6.75	qz	20.1
Al_2O_3	67	15.94	2.27	21.65	2.61	or	20.3
Fe_2O_3	67	1.24	0.03	4.41	0.83	ab	36.5
FeO	67	1.89	0.00	5.81	1.27	an	14.5
MgO	67	1.38	0.21	8.50	1.46	hy	5.5
CaO	67	3.03	0.08	8.52	1.57	mt	1.8
Na_2O	67	4.25	0.10	5.53	0.92	il	0.7
K_2O	67	3.39	0.78	7.81	1.21	ap	0.2
TiO_2	67	0.38	0.05	1.56	0.23		
MnO	67	0.09	0.01	0.27	0.05		
P_2O_5	67	0.17	0.01	0.90	0.15		
L.O.I.	67	0.73	0.29	1.59	0.28		
CALCTOT	33	99.16				total	99.7
PPM						DI= 77.0	
Cu	67	13.82	1.00	96.00	17.30		
Zn	67	58.81	5.00	163.00	27.41		
Pb	67	13.57	1.00	31.00	7.04		
Ni	62	7.44	1.00	84.00	15.20		
Li	67	17.40	5.00	39.00	6.37		
Mo	67	3.54	2.00	6.00	0.89		
U	67	1.01	0.40	2.30	0.44		
F	67	419.85	65.00	1653.00	276.97		
BaX	67	1604.37	167.00	4705.00	848.12		
SrX	67	764.16	23.00	1630.00	298.76		
RbX	67	77.54	15.00	174.00	27.42		
CrX	67	16.19	5.00	288.00	44.84		
VX	67	49.21	5.00	226.00	44.12		
NbX	67	8.66	1.00	32.00	4.87		
ZrX	66	120.77	8.00	333.00	57.50		
YX	67	18.51	1.00	82.00	12.89		
ThX	67	2.40	1.00	26.00	3.72		
GaX	67	17.97	5.00	27.00	3.59		
CeX	67	34.19	5.00	101.00	15.24		
LaX	67	17.06	2.00	51.00	9.19		

Unit Hgd-Ky — Kyanite gneiss

Wt. %	N	mean	Range min.	Range max.	S.D.
SiO_2	16	67.59	60.80	76.60	4.32
Al_2O_3	16	15.78	11.05	18.70	2.01
Fe_2O_3	16	2.79	0.14	4.73	1.18
FeO	16	1.65	0.33	2.44	0.62
MgO	16	1.43	0.22	2.55	0.65
CaO	16	1.12	0.85	1.41	0.17
Na_2O	16	2.60	2.19	3.38	0.34
K_2O	16	4.26	2.80	5.98	0.98
TiO_2	16	0.60	0.08	0.90	0.21
MnO	16	0.08	0.02	0.16	0.04
P_2O_5	16	0.07	0.04	0.11	0.02
L.O.I.	16	0.98	0.57	1.33	0.24
CALCTOT	16	98.96			
PPM					
Cu	16	9.81	2.00	38.00	9.87
Zn	16	69.69	12.00	117.00	28.25
Pb	16	19.13	12.00	31.00	4.59
Ni	16	16.44	2.00	38.00	9.34
Li	16	16.31	4.00	27.00	6.58
Mo	16	2.88	2.00	4.00	0.62
U	16	2.14	0.80	3.10	0.55
F	16	425.69	59.00	721.00	199.13
BaX	16	1158.13	715.00	1458.00	200.40
SrX	16	266.13	199.00	360.00	40.32
RbX	16	113.06	66.00	161.00	27.80
CrX	16	23.25	5.00	51.00	15.08
VX	16	58.56	5.00	88.00	21.08
NbX	16	15.25	3.00	24.00	4.61
ZrX	16	247.13	18.00	351.00	80.11
YX	16	32.25	23.00	41.00	5.16
ThX	16	10.88	2.00	17.00	4.44
GaX	16	17.38	7.00	26.00	5.24
CeX	16	49.81	17.00	77.00	12.77
LaX	16	25.00	5.00	37.00	7.42

Unit Hgr-bg — Granitic gneiss

Wt. %	N	mean	Range min.	max.	S.D.	CIPW	norm
SiO_2	120	69.79	45.70	79.60	6.31	qz	27.8
Al_2O_3	120	13.89	8.65	21.65	1.78	co	0.6
Fe_2O_3	120	1.23	0.01	5.34	1.07	or	28.6
FeO	120	2.09	0.00	8.78	1.63	ab	26.9
MgO	120	1.03	0.05	8.06	1.36	an	8.2
CaO	120	1.74	0.11	9.40	1.71	hy	4.7
Na_2O	120	3.13	1.08	5.97	0.79	mt	1.8
K_2O	120	4.77	0.69	10.38	1.65	il	0.9
TiO_2	120	0.51	0.05	2.44	0.37	ap	0.2
MnO	120	0.07	0.01	0.31	0.05		
P_2O_5	120	0.09	0.01	0.75	0.09		
L.O.I.	120	0.94	0.25	4.56	0.64		
CALCTOT	2	99.29				total	99.7
PPM						DI= 83.4	
Cu	120	16.30	1.00	194.00	27.01		
Zn	120	55.38	6.00	229.00	32.70		
Pb	120	22.11	1.00	113.00	14.40		
Ni	114	8.76	1.00	115.00	15.70		
Li	120	13.37	1.00	43.00	8.15		
Mo	120	3.49	2.00	22.00	1.92		
U	120	3.96	0.10	61.20	6.56		
F	120	420.73	29.00	1596.00	295.70		
BaX	120	755.20	33.00	2332.00	402.49		
SrX	120	161.44	15.00	1065.00	152.39		
RbX	120	178.59	20.00	333.00	69.55		
CrX	120	12.49	5.00	214.00	29.31		
VX	120	41.57	5.00	356.00	58.31		
NbX	120	16.97	1.00	80.00	10.15		
ZrX	120	255.88	36.00	795.00	148.39		
YX	120	52.14	3.00	182.00	38.67		
ThX	120	15.37	1.00	51.00	10.72		
GaX	120	16.09	8.00	28.00	3.72		
CeX	120	50.60	5.00	221.00	25.60		
LaX	120	23.04	5.00	138.00	15.00		

Unit Hgr-gd — Garnet granodiorite gneiss

Wt. %	N	mean	Range min.	max.	S.D.	CIPW	norm
SiO_2	9	65.17	44.30	77.00	10.12	qz	24.8
Al_2O_3	9	14.49	10.65	17.45	2.49	co	1.5
Fe_2O_3	9	2.00	0.31	5.45	1.80	or	18.3
FeO	9	4.31	0.00	13.29	3.82	ab	26.9
MgO	9	2.21	0.28	6.91	1.96	an	12.4
CaO	9	2.70	0.41	5.35	1.61	hy	10.7
Na_2O	9	3.13	2.33	4.56	0.72	mt	2.9
K_2O	9	3.05	0.80	6.37	1.69	il	1.6
TiO_2	9	0.84	0.37	2.65	0.72	ap	0.4
MnO	9	0.12	0.04	0.26	0.08		
P_2O_5	9	0.18	0.02	0.51	0.19		
L.O.I.	9	0.77	0.00	1.52	0.42		
CALCTOT	9	98.98				total	99.5
PPM						DI= 70.0	
Cu	9	22.00	3.00	50.00	17.73		
Zn	9	76.89	32.00	124.00	27.74		
Pb	8	14.25	4.00	31.00	9.29		
Ni	9	27.56	1.00	86.00	27.00		
Li	9	19.78	9.00	53.00	15.04		
Mo	9	4.89	2.00	18.00	4.99		
U	9	2.17	1.20	3.10	0.63		
F	9	740.89	282.00	1653.00	473.48		
BaX	9	612.56	198.00	1421.00	403.40		
SrX	9	214.22	32.00	454.00	151.04		
RbX	9	130.22	36.00	216.00	59.20		
CrX	9	40.44	5.00	160.00	49.84		
VX	9	87.78	5.00	197.00	66.24		
NbX	9	16.22	7.00	22.00	4.35		
ZrX	9	259.44	128.00	446.00	110.57		
YX	9	47.00	15.00	128.00	33.75		
ThX	9	6.22	1.00	13.00	5.21		
GaX	9	17.78	10.00	32.00	6.44		
CeX	9	46.44	20.00	74.00	16.50		
LaX	9	22.33	14.00	39.00	7.55		

Unit Hgr-ag — Aplite gneiss

Wt. %	N	mean	Range min.	max.	S.D.	CIPW	norm
SiO_2	21	72.17	49.80	77.70	6.09	qz	29.6
Al_2O_3	21	13.03	11.00	15.60	1.19	or	33.3
Fe_2O_3	21	0.85	0.01	3.99	0.93	ab	25.4
FeO	21	1.77	0.51	10.24	2.05	an	5.8
MgO	21	0.63	0.07	4.94	1.03	hy	3.6
CaO	21	1.26	0.25	8.10	1.63	mt	1.2
Na_2O	21	2.97	1.74	4.20	0.53	il	0.7
K_2O	21	5.57	1.97	7.60	1.33	ap	0.2
TiO_2	21	0.40	0.10	2.12	0.42		
MnO	21	0.05	0.01	0.23	0.05		
P_2O_5	21	0.07	0.01	0.25	0.06		
L.O.I.	21	0.75	0.39	1.40	0.30		
CALCTOT	21	99.51				total	99.8
PPM						DI= 88.3	
Cu	21	17.48	1.00	180.00	39.33		
Zn	21	46.19	11.00	153.00	34.39		
Pb	21	24.33	4.00	39.00	8.71		
Ni	20	3.65	1.00	24.00	5.13		
Li	21	10.95	2.00	27.00	7.27		
Mo	21	3.29	2.00	5.00	0.64		
U	21	4.30	1.30	18.40	3.84		
F	21	314.71	18.00	971.00	250.55		
BaX	21	593.24	10.00	2501.00	564.34		
SrX	21	98.67	7.00	646.00	133.06		
RbX	21	218.24	114.00	320.00	58.30		
CrX	21	8.81	5.00	85.00	17.46		
VX	21	36.81	5.00	446.00	94.99		
NbX	21	17.71	6.00	29.00	6.97		
ZrX	21	232.29	60.00	647.00	133.47		
YX	21	60.14	7.00	147.00	32.93		
ThX	21	21.57	1.00	65.00	15.57		
GaX	21	15.10	9.00	24.00	3.79		
CeX	21	49.10	20.00	96.00	19.03		
LaX	21	20.38	5.00	49.00	14.26		

Table 2. Mineral analyses and ionic proportions

Analyses in weight per cent.

Ionic proportions are calculated on the basis of 12 (O) for garnet, 6 (O) for pyroxene, 24 (O, OH, F) for biotite and muscovite and 8 (O) for plagioclase.

In garnet, Py= pyrope, Gr= grossular, Sp= spessartine, Al= almandine; Py:Gr:Sp:Al is Mg:Ca:Mn:Fe.

In feldspar, Ab= albite, An= anorthite, Or= orthoclase; Ab:An:Or is Na:Ca:K.

In pyroxene, Di= diopside, Hd= hedenbergite, En= enstatite, Fs= ferrosilite (calculated considering only (CaMg),(CaFe),(Mg) and (Fe) end-members).

Mineral assemblages

Excluding chlorite, sericite, epidote, sphene and other accessory or retrograde phases.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Sample number
x	x	x	x	x	x	x	x	x	x			x	x	x	x		x	quartz
x		x		x	x	x	x	x	x		x	x	x				x	K-feldspar
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	plagioclase
x	x	x	x	x	x	x	x	x	x	x	x	x						biotite
		x		x			x					x						muscovite
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			garnet
x	x	x	x	x	x	x	x		x	x		x				x	x	opaque material
										x	x					x	x	orthopyroxene
								x	x				x	x	x	x	x	clinopyroxene
			x		x			x	x	x	x		x	x		x	x	hornblende
			x										x	x		x		scapolite
							x											kyanite
PE82-58	PE82-235	PE82-72A	PE82-102	GB82-4B	PE82-111	MW82-127	MW82-118	PE82-247	PE82-98B	PE82-234B	PE82-90	PE82-87	PE82-118	MW82-123B	MW82-27B	MW82-21	PE82-100	Field number

Sample 1 — Hgd-mu, muscovite gneiss

	Garnet	Biotite	Plagioclase	Muscovite
Na_2O	0.01	0.02	9.38	0.29
MgO	1.33	8.39	0.05	1.50
Al_2O_3	19.43	15.66	21.71	27.68
SiO_2	38.28	36.89	66.14	48.73
K_2O	0.00	9.75	0.20	10.34
CaO	4.82	0.04	3.57	0.02
TiO_2	0.02	2.96	0.00	1.07
Cr_2O_3	0.00	0.02	0.00	0.00
MnO	17.48	0.82	0.01	0.08
FeO	20.54	20.82	0.03	6.34
NiO	0.02	0.00	0.02	0.03
Total	101.93	95.38	101.11	96.08
Na	0.00155	0.00543	0.79167	0.069188
Mg	0.15846	1.75073	0.00324	0.27506
Al	1.83213	2.58626	1.11462	4.01719
Si	3.06021	5.16517	2.87889	5.99582
K	0	1.74165	0.01110	1.62313
Ca	0.41288	0.00600	0.16650	0.09901
Cr	0	0.00221	0	0
Mn	1.18367	0.09725	0	0.00834
Fe	1.37327	2.43799	0	0.65240
Ni	0.00129	0	0	0.00297
Fe+3	0.04503	—	—	—
Fe+2	1.32823	—	—	—
	Py 5.1 %	Mg/Fe= 0.718	81.7% Ab	
	Gr 13.2		17.2 An	
	Sp 37.8		1.1 Or	
	Al 43.9			

Sample 2 — Hgr-gd, granodiorite gneiss

	Garnet	Biotite	Plagioclase
Na_2O	0.01	0.05	8.24
MgO	5.23	11.09	0.00
Al_2O_3	20.76	15.48	23.52
SiO_2	38.70	36.39	63.75
K_2O	0.00	8.34	0.37
CaO	1.95	0.18	5.52
TiO_2	0.02	4.00	0.00
Cr_2O_3	0.02	0.11	0.00
MnO	1.00	0.07	0.02
FeO	33.39	19.38	0.02
NiO	0.00	0.00	0.01
Total	101.08	95.59	101.44
Na	0.00152	0.01336	0.69739
Mg	0.61200	2.27849	0
Al	1.92266	2.51715	1.21091
Si	3.03065	5.01667	2.78260
K	0	1.46683	0.02060
Ca	0.16406	0.02659	0.25817
Ti	0.00118	0.41499	0
Cr	0.00124	0.01199	0
Mn	0.06651	0.06651	0.00074
Fe	2.19261	2.29206	0.00030
Ni	0	0	0.00002
Fe+2	2.19261	—	—
	Py 20.2%	Mg/Fe= 0.994	71.4% Ab
	Gr 5.4		26.4 An
	Sp 2.2		2.1 Or
	Al 72.2		

Sample 3 — Hgd-ky, kyanite gneiss

	Garnet	Biotite	Plagioclase
Na_2O	0.20	0.13	9.87
MgO	4.30	12.26	0.01
Al_2O_3	20.64	17.85	21.66
SiO_2	39.02	38.27	65.52
K_2O	0.01	9.29	0.25
CaO	2.26	0.00	4.38
TiO_2	0.00	2.63	0.00
Cr_2O_3	0.02	0.02	0.00
MnO	10.89	0.28	0.04
FeO	23.65	15.04	.01
NiO	0.00	0.00	.00
Total	100.80	95.58	101.74
Na	0.00305	0.03386	0.8329
Mg	0.50452	2.45447	0.0006
Al	1.91666	2.79663	1.111
Si	3.07198	5.14096	2.8514
K	0.00100	1.59215	0.013
Ca	0.19065	0.	0.204
Ti	0	0.26570	0
Cr	0.00124	0.00319	0
Mn	0.72622	0.03186	0.001
Fe	1.55718	1.68970	0.0003
Ni	0	0	0
Fe^{+2}	1.55718	—	—
	Py 19.9%	Mg/Fe= 1.329	79.3% Ab
	Gr 6.4		19.4 An
	Sp 24.4		1.2 Or
	Al 52.3		

Sample 4 — Hgd-g, amphibolite gneiss

	Garnet	Biotite	Plagioclase
Na_2O	0.00	0.05	8.89
MgO	4.67	11.55	0.00
Al_2O_3	20.19	14.20	23.32
SiO_2	40.36	37.26	64.78
K_2O	0.02	9.12	0.34
CaO	9.00	0.00	4.95
TiO_2	0.04	4.91	0.00
Cr_2O_3	0.00	0.00	0.00
MnO	2.37	0.12	0.00
FeO	24.77	18.81	0.07
NiO	0.04	0.00	0.05
Total	101 45	96.02	102.46
Na	0	0.01329	0.74514
Mg	0.53587	2.35913	0
Al	1.83358	2.29553	1.18902
Si	3.10749	5.10660	2.80025
K	0.00196	1.50465	0.02151
Ca	0.74250	0	0.22927
Ti	0.00232	0.50609	0
Cr	0	0	0
Mn	0.15457	0.01393	0
Fe	1.59500	2.15602	0.00253
Ni	0.00248	0	0.00174
Fe^{+2}	1.59500	—	—
	Py 17.7%	Mg/Fe= 1.094	74.8% Ab
	Gr 24.5		23.0 An
	Sp 5.1		1.1 Or
	Al 52.7		

Sample 5 — Hgd-ky, kyanite gneiss

	Garnet	Biotite	Plagioclase
Na_2O	0.03	0.00	9.55
MgO	4.65	10.80	0.00
Al_2O_3	20.23	19.05	22.36
SiO_2	39.08	38.64	65.39
K_2O	0.00	8.20	0.17
CaO	1.64	0.07	4.30
TiO_2	0.00	2.22	0.00
Cr_2O_3	0.00	0.02	0.00
MnO	9.96	0.22	0.02
FeO	25.13	13.86	0.00
NiO	0.03	0.06	0.00
Total	100.77	93.14	101.80
Na	0.00457	0	0.80374
Mg	0.54411	2.18159	0
Al	1.87349	3.04555	1.14475
Si	3.06835	5.23736	2.83822
K	0	1.41795	0.00941
Ca	0.13797	0.01017	0.19998
Ti	0	0.22630	0
Cr	0	0.00214	0
Mn	0.69765	0.02525	0.00074
Fe	1.67246	1.57110	0
Ni	0	0.00654	0
Fe^{+2}	1.67246	—	—
	Py 17.8%	Mg/Fe= 1.389	79.3% Ab
	Gr 4.5		19.7 An
	Sp 22.9		0.7 Or
	Al 54.8		

Sample 6 — Hmd-qm, quartz monzodiorite gneiss

	Garnet	Biotite
Na_2O	0.02	0.03
MgO	6.05	16.24
Al_2O_3	20.23	15.03
SiO_2	40.30	37.34
K_2O	0.00	8.21
CaO	7.80	0.05
TiO_2	0.04	3.90
Cr_2O_3	0.00	0.01
MnO	1.33	0.07
FeO	25.25	15.36
NiO	0.12	0.00
Total	101.15	96.23
Na	0.00298	0.00778
Mg	0.69283	3.23644
Al	1.83353 2.37063	
Si	3.09665	4.99315
K	0	1.40063
Ca	0.64221	0.00716
Ti	0.00231	0.39221
Cr	0	0.00106
Mn	0.08657	0.00793
Fe	1.62265	1.71778
Ni	0.00742	0
Fe^{+2}	1.62265	—
	Py 22.8%	Mg/Fe= 1.884
	Gr 21.1	
	Sp 2.8	
	Al 53.3	

Sample 7 — Hmd-gm, monzodiorite gneiss

	Garnet	Biotite
Na_2O	0.00	0.01
MgO	4.38	12.16
Al_2O_3	19.96	16.08
SiO_2	39.84	37.92
K_2O	0.01	9.02
CaO	3.29	0.00
TiO_2	0.00	3.49
Cr_2O_3	0.01	0.01
MnO	5.34	0.16
FeO	26.36	18.00
NiO	0.00	0.00
Total	101.18	96.84
Na	0	0.00261
Mg	0.51793	2.43888
Al	1.86802 2.55250	
Si	3.16108	5.10321
K	0.00101	1.54868
Ca	0.44975	0
Ti	0	0.35323
Cr	0	0.00106
Mn	0.35890	0.01824
Fe	1.55012	2.02592
Ni	0	0
Fe^{+2}	1.55012	—
	Py 18.0%	Mg/Fe= 1.204
	Gr 15.6	
	Sp 12.5	
	Al 53.9	

Sample 8 — Hgd-ky, kyanite gneiss

	Garnet	Biotite	Plagioclase
Na_2O	0.00	0.05	9.22
MgO	4.84	12.61	0.00
Al_2O_3	20.44	18.35	22.64
SiO_2	38.12	38.16	65.45
K_2O	0.00	9.00	0.17
CaO	2.43	0.00	4.66
TiO_2	0.00	2.13	0.00
Cr_2O_3	0.00	0.02	0.00
MnO	10.70	0.23	0.01
FeO	24.52	15.98	0.01
NiO	0.05	0.03	0.00
Total	101.12	96.55	102.17
Na	0	0.01291	0.76983
Mg	0.57016	2.50310	0
Al	1.90571	2.88274	1.14991
Si	3.01317	5.08246	2.81834
K	0	1.52929	0.00934
Ca	0.20581	0	0.21501
Ti	0	0.21335	0
Cr	0	0.00211	0
Mn	0.71641	0.02595	0
Fe	1.62094	1.77999	0
Ni	0.00318	0.00321	0
Fe^{+3}	0.06794	—	—
Fe^{+2}	1.55300	—	—
	Py 18.3%	Mg/Fe= 1.406	77.4% Ab
	Gr 6.6		21.6 An
	Sp 23.0		0.9 Or
	Al 51.7		

Sample 9 — Hbm, monzodiorite

	Garnet	Biotite	Plagioclase	Pyroxene
Na_2O	0.03	0.02	9.74	1.05
MgO	4.17	9.77	0.00	10.90
Al_2O_3	20.30	12.99	21.03	1.88
SiO_2	34.55	37.17	67.44	53.16
K_2O	0.01	8.74	0.20	0.00
CaO	6.57	0.00	2.69	20.00
TiO_2	0.08	5.65	0.04	0.11
Cr_2O_3	0.02	0.00	0.00	0.01
MnO	1.27	0.00	0.02	0.18
FeO	29.91	21.46	0.07	13.09
NiO	0.01	0.01	0.00	0.00
Total	101.92	95.81	101.79	100.38
Na	0.00452	0.00534	0.81336	0.7653
Mg	0.48260	2.02341	0	0.61064
Al	1.85938	2.12922	1.06828	0.08335
Si	3.07123	5.16535	2.92811	1.99831
K	0.00099	1.54953	0.01099	0
Ca	0.54667	0	0.12413	0.80557
Ti	0.00467	0.59049	0.00130	0.00311
Cr	0.00123	0	0	2.97185
Mn	0.08354	0	0.0072	0.00573
Fe	1.94249	2.4909	0.00252	0.41152
Ni	0.00062	0.00112	0	0
Fe^{+2}	1.9429	—	—	0.41152
	Py 15.8%	Mg/Fe= 0.811	85.8% Ab	51.8% Di
	Gr 17.9		13.1 An	36.2 Hd
	Sp 2.7		1.2 Or	7.1 En
	Al 63.3			4.9 Fs

Sample 10 — Hqmg, quartz monzorite

	Garnet	Biotite	Clinopyroxene
Na_2O	0.00	0.07	1.71
MgO	1.36	8.72	7.08
Al_2O_3	14.39	11.80	2.83
SiO_2	38.98	37.39	51.60
K_2O	0.00	8.50	0.01
CaO	6.25	0.00	17.75
TiO_2	0.02	4.82	0.25
Cr_2O_3	0.00	0.00	0.00
MnO	5.09	0.16	0.87
FeO	28.30	23.94	19.03
NiO	0.00	0.11	0.04
Total	99.38	95.50	101.17
Na	0	0.01923	0.12800
Mg	0.16326	1.84090	0.40734
Al	1.84216	1.97160	0.12887
Si	3.13970	5.29648	1.97118
K	0	1.53614	0.00049
Ca	0.53941	0	0.73424
Ti	0.00121	0.51344	0.00726
Cr	0	0	0
Mn	0.34728	0.01920	0.02845
Fe	1.90637	2.78522	0.61441
Ni	0	0.0014	0.00124
Fe^{+2}	1.90637	—	0.61441
	Py 5.5%	Mg/Fe= 0.661	33.5% Di
	Gr 18.2		50.5 Hd
	Sp 11.7		9.6 En
	Al 64.5		9.6 Fs

Sample 11 — Hgr-gd, garnet amphibolite gneiss

	Garnet	Biotite	Orthopyroxene	Plagioclase
Na_2O	0.01	2.08	0.04	7.22
MgO	6.31	11.28	17.69	0.00
Al_2O_3	20.54	11.61	3.11	25.27
SiO_2	39.01	42.78	50.84	61.84
K_2O	0.00	0.47	0.24	0.10
CaO	3.50	9.96	0.33	7.58
TiO_2	0.00	1.04	0.05	0.00
Cr_2O_3	0.00	0.00	0.01	0.00
MnO	0.71	0.04	0.25	0.01
FeO	29.21	17.04	28.98	0.06
NiO	0.00	0.00	0.10	0.03
Total	99.30	96.34	101.63	102.11
Na	0.00153	0.53144	0.00293	0.61016
Mg	0.73977	2.21514	0.99671	0
Al	1.90587	1.80446	0.13868	1.29909
Si	3.06876	5.63703	1.92206	2.64524
K	0.00100	0.07401	0.01157	0.00556
Ca	0.29502	1.40625	0.01337	0.35399
Ti	0	0.10306	0.00142	0
Cr	0	0	0.00029	0
Mn	0.04731	0.01005	0.00801	0
Fe	1.92174	1.87782	0.41624	0
Ni	0	0	0.00304	0
Fe^{+3}	—	—	0.02868	—
Fe^{+2}	1.92174	—	0.88761	—
	Py 24.6%	Mg/Fe= 1.180	1.2% Di	62.9% Ab
	Gr 9.8		0.8 Hd	36.5 An
	Sp 1.6		69.2 En	0.6 Or
	Al 64.0		28.8 Fs	

Sample 12 — Hum, olivine hornblendite

	Garnet	Biotite	Plagioclase
Na_2O	0.03	0.15	8.48
MgO	9.59	18.60	0.04
Al_2O_3	21.30	15.84	23.40
SiO_2	8.93	37.33	62.96
K_2O	0.02	9.02	0.14
CaO	4.63	0.09	0.14
TiO_2	0.00	1.44	0.00
Cr_2O_3	0.00	0.00	0.00
MnO	1.81	0.05	0.00
FeO	25.12	11.71	0.19
NiO	0.00	0.12	0.00
Total	101.43	94.41	100.79
Na	0.00443	0.03915	0.72356
Mg	1.08988	3.73149	0.00262
Al	1.91585	2.52299	1.21457
Si	2.96867	5.02511	2.77055
K	0.00195	1.54909	0.00786
Ca	0.37831	0.01298	0.26263
Ti	0	0.14578	0
Cr	0	0	0
Mn	0.11691	0.00570	0
Fe	1.60204	1.31832	0.00699
Ni	0	0.01299	0
Fe^{+3}	0.14682	—	—
Fe^{+2}	1.45522	—	—
	Py 34.2%	Mg/Fe= 2.830	72.8% Ab
	Gr 11.9		26.4 An
	Sp 3.7		0.8 Or
	Al 50.3		

Sample 13 — Hgd-ky, biotite-muscovite gneiss

	Garnet	Biotite	Plagioclase	Muscovite
Na_2O	0.05	0.09	0.18	0.17
MgO	2.74	11.30	0.02	1.46
Al_2O_3	20.24	16.12	17.84	30.93
SiO_2	34.05	37.71	67.77	50.42
K_2O	0.00	9.32	15.80	9.42
CaO	2.17	0.00	0.00	0.00
TiO_2	0.01	3.07	0.02	1.00
Cr_2O_3	0.00	0.03	0.00	0.03
MnO	13.92	0.47	0.00	0.00
FeO	22.00	17.57	0.06	4.74
NiO	0.03	0.00	0.04	0.01
Total	100.21	95.69	101.73	98.18
Na	0.00772	0.02383	0.81369	0.04011
Mg	0.32282	2.29836	0	0.26476
Al	1.90120	2.59494	1.[illegible]0872	4.29569
Si	3.10981	5.14653	[illegible].92930	6.01345
K	0	1.62276	0.01099	1.30712
Ca	0.18517	0	0.12418	0
Ti	0.00599	0.31510	0.00130	0.09151
Cr	0	0.00324	0	0.00289
Mn	0.43900	0.05433	0	0
Fe	1.46525	2.00542	0	0.40706
Ni	0.00192	0	0	0
Fe^{+2}	1.46525	—	—	—
	Py 13.4%	Mg/Fe= 1.146	85.8% Ab	
	Gr 7.7		13.0 An	
	Sp 18.2		1.2 Or	
	Al 60.7			

Sample 14 — Hmd-qm, monzodiorite gneiss

	Garnet	Clinopyroxene
Na_2O	0.07	1.21
MgO	6.66	12.32
Al_2O_3	20.18	3.93
SiO_2	37.73	50.88
K_2O	0.00	0.00
CaO	8.94	21.64
TiO_2	0.08	0.28
Cr_2O_3	0.00	0.02
MnO	1.47	0.28
FeO	24.23	9.73
NiO	0.00	0.00
Total	99.36	100.29
Na	0.01069	0.08785
Mg	0.78181	0.68745
Al	1.97486 0.17356	
Si	2.97187	1.900502
K	0	0
Ca	0.75453	0.86817
Ti	0.00474	0.00788
Cr	0	0.00059
Mn	0.09808	0.00888
Fe	1.59614	0.30468
Ni	0	0
Fe^{+3}	0.17142	0.00005
Fe^{+2}	1.4232	0.30463
	Py 24.2%	65.7% Di
	Gr 23.4	28.3 Hd
	Sp 3.0	4.2 En
	Al 49.4	1.8 Fs

Sample 15 — Hmd-gm, horneblende monzodiorite gneiss

	Garnet	Clinopyroxene	Plagioclase
Na_2O	0.02	0.71	6.75
MgO	3.63	10.34	0.00
Al_2O_3	20.39	5.95	25.78
SiO_2	40.17	49.65	58.28
K_2O	0.00	0.01	0.19
CaO	13.48	22.24	8.84
TiO_2	0.04	0.45	0.00
Cr_2O_3	0.02	0.01	0.00
MnO	0.62	0.10	0.01
FeO	23.38	10.90	0.13
NiO	0.05	0.00	0.00
Total	101.78	100.35	99.99
Na	0.00299	0.05174	0.58691
Mg	0.41672	0.57915	0
Al	1.81716	0.26376	1.36356
Si	3.09429	1.86600	2.61340
K	0	4.79484	0.01087
Ca	1.11261	0.89561	0.42475
Ti	0.00232	0.01272	0
Cr	0.00122	0.00029	0
Mn	0.04045	0.00318	3.79837
Fe	1.50619	0.34261	0.00488
Ni	0.00310	0	0
Fe^{+2}	1.50619	0.34261	—
	Py 13.5%	61.0% Di	57.4% Ab
	Gr 36.2	37.0 Hd	41.5 An
	Sp 1.3	1.3 En	1.1 Or
	Al 49.0	0.7 Fs	

Sample 16 — Hgd-mu, garnet-pyroxene layer in gneiss

	Garnet	Clinopyroxene	Plagioclase
Na_2O	0.00	1.92	7.96
MgO	11.30	13.11	0.00
Al_2O_3	21.61	7.14	24.17
SiO_2	41.86	52.34	62.20
K_2O	0.00	0.00	0.31
CaO	8.53	20.02	6.60
TiO_2	0.00	0.43	0.00
Cr_2O_3	0.00	0.00	0.00
MnO	0.38	0.07	0.02
FeO	17.88	4.79	0.05
NiO	0.03	0.02	0.01
Total	101.59	99.84	101.32
Na	0	0.13547	0.67796
Mg	1.23817	0.71097	0
Al	1.87405	0.30646	1.25225
Si	3.07766	1.90459	2.733212
K	0	0	0.01737
Ca	0.67199	0.78060	0.31063
Ti	0	0.01177	0
Cr	0	0	0
Mn	0.02367	0.00216	0
Fe	1.09942	0.14577	0
Ni	0.00177	0.00058	0
Fe^{+2}	1.09942	0.14577	—
	Py 40.8%	80.0% Di	67.4% Ab
	Gr 22.2	16.0 Hd	30.9 An
	Sp 0.8	3.2 En	1.7 Or
	Al 36.2	0.8 Fs	

Sample 17 — Hlcn, leuconorite

	Clinopyroxene	Orthopyroxene	Plagioclase
Na_2O	0.38	0.00	5.25
MgO	13.34	21.69	0.04
Al_2O_3	2.66	1.11	26.70
SiO_2	50.96	53.03	57.33
K_2O	0.00	0.01	0.40
CaO	21.52	0.73	10.34
TiO_2	0.37	0.11	0.00
Cr_2O_3	0.02	0.03	0.00
MnO	0.16	0.46	0.00
FeO	9.80	24.36	0.04
NiO	0.00	0.02	0.04
Total	99.20	102.55	100.13
Na	0.02783	0	0.45660
Mg	0.75096	1.9637	0.00267
Al	0.11851	0.04846	1.41256
Si	1.92491	1.96266	2.57143
K	0	0.00047	0.02289
Ca	0.87100	0.02895	0.49694
Ti	0.01051	0.00306	0
Cr	0.00059	0.00087	0
Mn	0.00512	0.01442	0
Fe	0.30459	0.75401	0
Ni	0	5.45358	0
Fe^{+3}	0.01005	0.02028	—
Fe^{+2}	0.29954	0.73373	—
	Di 64.1%	1.2%	46.8% Ab
	Hd 26.9	0.8	50.9 An
	En 6.3	61.0	2.3 Or
	Fs 2.7	37.0	

Sample 18 — Hgr-bg, quartzofeldspathic mylonite

	Orthopyroxene	Clinopyroxene	Plagioclase
Na_2O	0.05	1.01	8.21
MgO	18.62	11.71	0.00
Al_2O_3	1.41	2.85	23.95
SiO_2	51.05	50.37	61.93
K_2O	0.01	0.01	0.32
CaO	0.43	21.19	6.04
TiO_2	0.06	0.32	0.02
Cr_2O_3	0.00	0.02	0.00
MnO	1.03	0.38	0.01
FeO	28.86	12.65	0.06
NiO	0.00	0.06	0.00
Total	101.51	100.56	100.54
Na	0.00368	0.07419	0.70386
Mg	1.05407	0.66115	0
Al	0.06317	0.12735	1.24903
Si	1.93912	1.90823	2.73818
K	0.00048	0.00048	0.01805
Ca	0.01750	0.86017	0.28615
Ti	0.00171	0.00912	6.65039
Cr	0	0.00059	0
Mn	0.03314	0.01214	3.74518
Fe	0.91681	0.40080	0.00222
Ni	0	0.00183	0
Fe^{+3}	0.05564	0.03966	—
Fe^{+2}	0.86118	0.36113	—
	Di 1.6%	56.4%	69.8% Ab
	Hd 1.4	33.6	28.4 An
	En 53.0	6.3	1.8 Or
	Fs 44.0	3.7	

Table 3. Results of garnet-biotite and garnet-pyroxene geothermometry applied to rocks of the Groswater Bay and Lake Melville terranes (see also Fig. 19). Mineral analyses are given in Table 2.

Temperature in °C.
Garnet-biotite results are following the method of Ferry and Spear (1978) (FS); garnet-pyroxene calculations are following Ellis and Green's (1979) method (EG). A correction to the Ferry and Spear thermometer has been proposed by Pigage and Greenwood (1982). This takes account of the Ca and Mn content of the garnet. The results of the correction are shown in the column under PG. Whereas the Pigage and Greenwood correction can be expected to raise the calculated temperatures by 10 to 20%, the increases in temperature observed here are implausible. This suggests that the Pigage and Greenwood correction, based on the excess parameters of Ganguly (1979), cannot be applied to rocks in which the Ca and Mn content of garnet is relatively large (in this case, two to three times that of garnets analyzed by Pigage and Greenwood). All calculations follow the original authors' assumption(s) about activity-composition relations and thermodynamic data, unless stated otherwise (see text).

Sample	FS		PG		EG		Location	
	9 kb	4 kb	9 kb	4 kb	9 kb	3 kb	Latitude N	Longitude W
1	560	542	830	812			53°53′30″	60°17′
2	787	764	842	818			54°03′20″	59°07′30″
3	679	658	863	842			53°58′	60°02′
4	835	811	1067	1042			53°51′	60°01′
5	701	680	866	845			53°47′	60°23′
6	686	666	850	829			53°51′30″	59°57′30″
7	780	757	986	962			53°51′30″	60°11′
8	730	708	917	896			53°56′	60°03′
9	833	809	996	971	729	715	53°49′30″	60°09′
10	496	480	653	636	681	655	53°50′40″	60°07′30″
11	870	845	961	936	882	880	54°03′30″	59°07′
12	712	690	818	797			53°48′20″	60°22′
13	621	602	836	816			53°48′	60°24′
14					895	860	53°53′30″	59°54′
15					875	830	53°55′	60°08′
16					861	840	53°47′30″	60°13′

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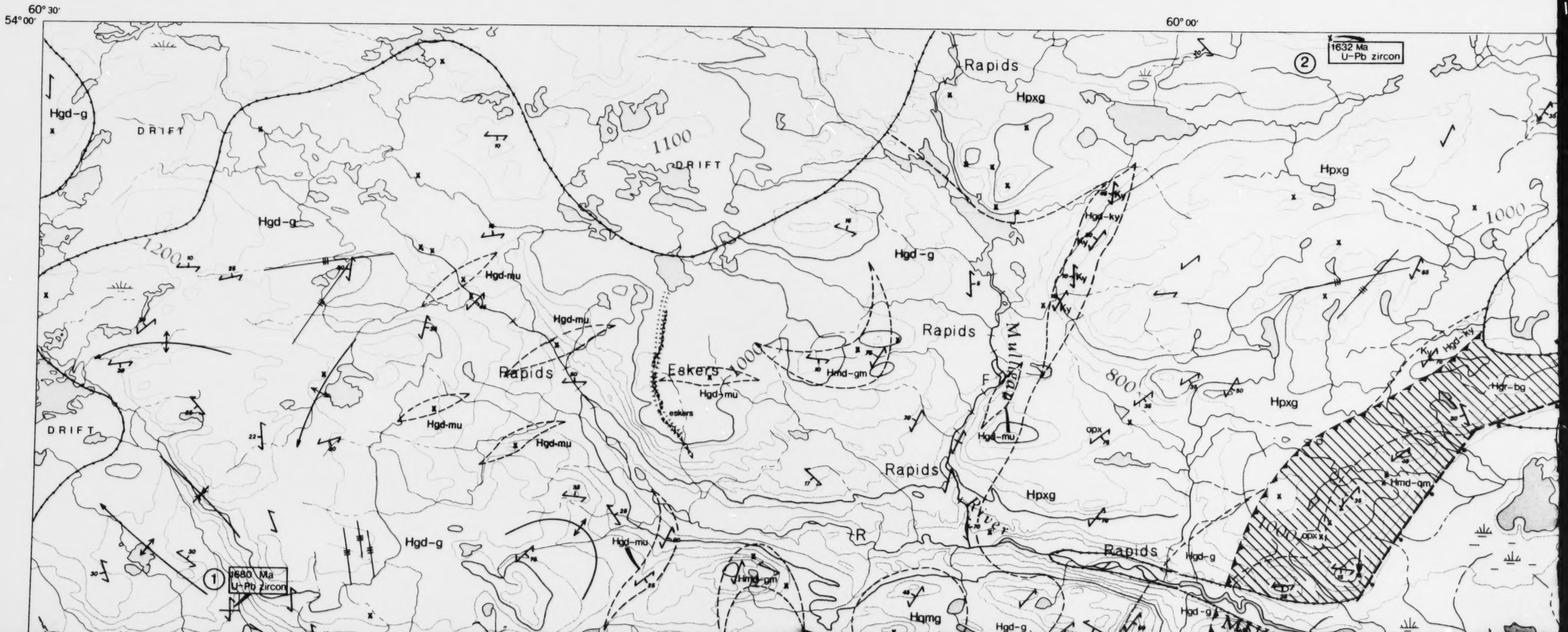

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MINERAL DEVELOPMENT DIVISION
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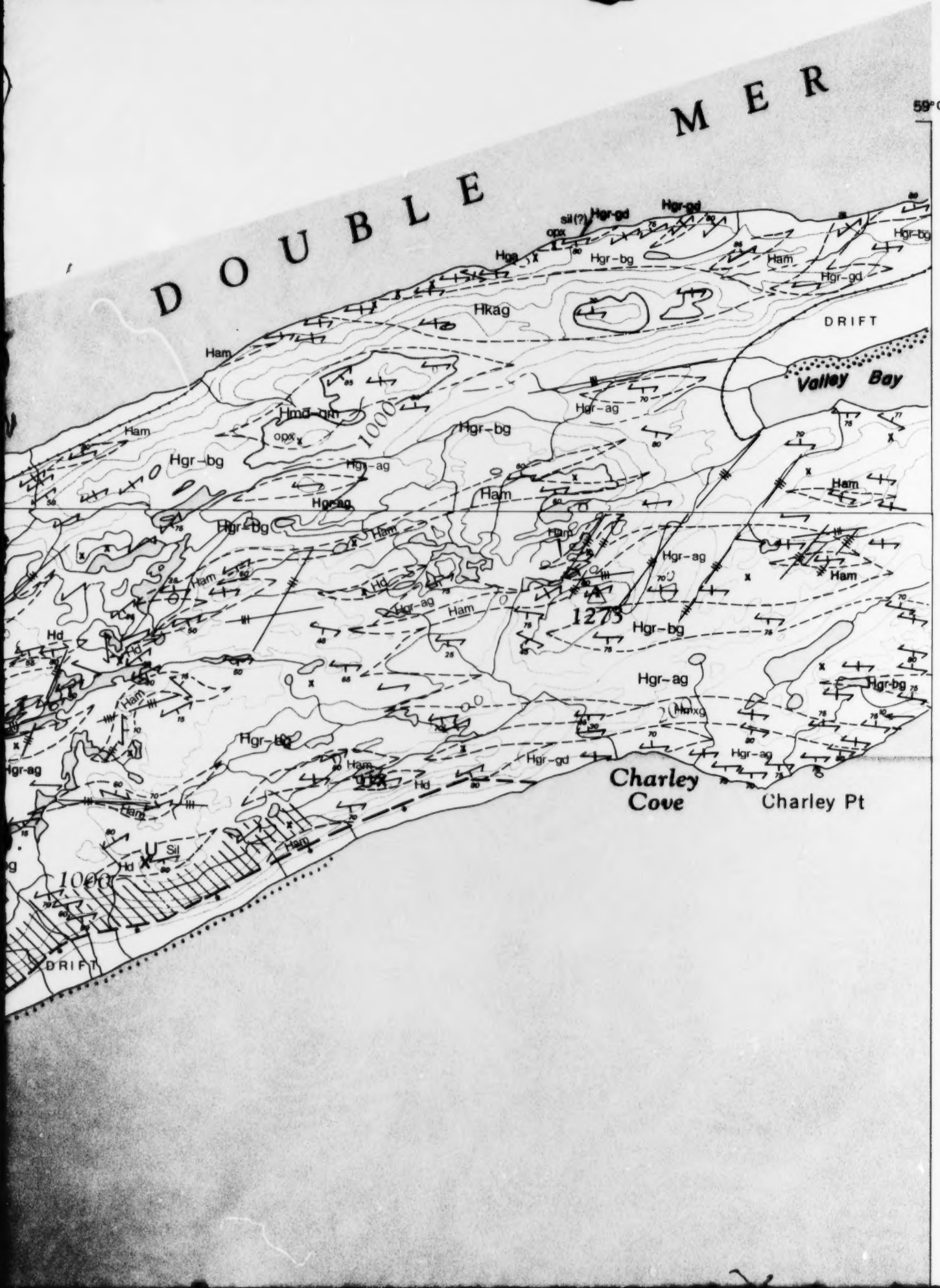
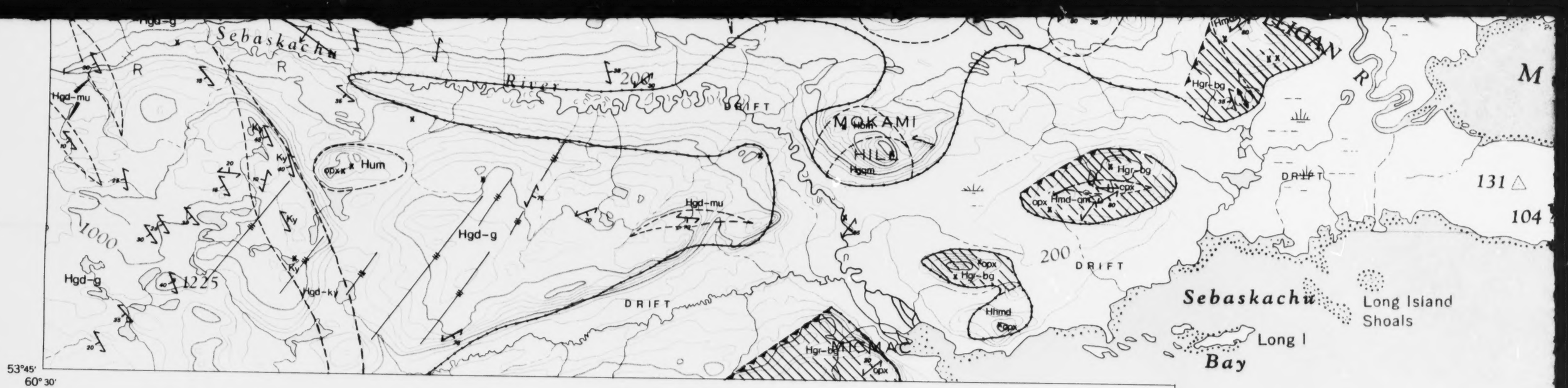
1632 Ma
U-Pb zircon

Hpxg
Hmd-gra
Hgr-bg
Hgr-ag
Hgr-gd
Hmd-qm
HaPdm
Hpd-ky
Ham
Hd
DRIFT
THE HIGHLANDS
Pearl River
Lowland Pt
1570
1000
600
400
100


DOUBLE MER
59° 00'
54° 05'
54°00'
Valley Bay
Charley Cove
Charley Pt
DRIFT
DRIFT
1000
1000
1275
Hkag
Hgr-bg
Hgr-ag
Hgr-gd
Ham
Hd
Hmd-gm
Hmxg
sil(?)
opx
Sil



LEGEND

HADRYNIAN OR PALEOZOIC

HaPdm Double Mer Formation: red arkose and polymictic, clast-supported conglomerate, pebbly sandstone and minor shale; medium to thick-bedded

HELIKIAN OR EARLIER

Hd Coarse grained, massive, locally equigranular, chalky weathering quartzofeldspathic diatexite or pegmatite

Hum Coarse grained olivine hornblendite and minor olivine-bearing ultramafic rock types; massive

Hga Medium grained, massive, equigranular gabbro and metagabbro

Hqmg Pink, coarse grained, massive to weakly foliated biotite quartz monzonite and granite

Hgqm Buff, resistant, massive to well foliated, coarse grained, hornblende granite to quartz monzonite

Hpxg Pink to buff, coarse grained, homogeneous, biotite and clinopyroxene granite; massive to weakly foliated

Hbm Massive, equigranular, coarse grained, brown biotite monzodiorite

Mealy Mountains Intrusive Suite

Hod Mealy dykes: olivine diabase, fine to medium grained

Hlcn Medium to coarse grained, dark, andesine leuconorite and anorthosite; massive

Hmnz Massive, medium grained, equigranular pyroxene and fayalite monzonite, quartz monzonite, granite and monzodiorite

Hlct Medium to coarse grained, dark, labradorite leucotroctolite and anorthosite, with minor troctolite, olivine gabbro and leuconorite; massive

Hhmd Pink, well foliated, medium grained hornblende and biotite leucomonzodiorite to diorite gneiss

Hmxg Homogeneous, coarse grained, pink, leucocratic, megacrystic (K-feldspar), biotite and hornblende granite orthogneiss; moderately foliated

Hkag Homogeneous, coarse grained, grey augen (K-feldspar and plagioclase), biotite granite orthogneiss; strongly foliated

Hmd-qm Medium grained, granoblastic, dark, dense, hornblende quartz monzodiorite gneiss, garnet amphibolite and

Hmd-gm Medium grained, dark, equigranular, hornblende monzodiorite to garnetiferous hornblende monzodiorite gneiss; clinopyroxene- and scapolite-bearing in places

Hmd-gra Fine to medium grained, dark, homogeneous, equigranular, two-pyroxene-plagioclase granulite gneiss

Ham Medium grained amphibolite, micaceous amphibolite, and minor clinopyroxene amphibolite gneiss; granoblastic to strongly schistose; commonly well foliated

Hgd-g Medium grained, grey (salt-and-pepper), strongly banded, biotite, hornblende and epidote granodiorite gneiss; commonly with accessory epidote, and migmatitic

Hgd-mu Well banded, medium to coarse grained, light pink, quartz-feldspar muscovite gneiss; granoblastic, migmatitic

Hgd-ky Granoblastic, finely banded, pink to white kyanite quartzofeldspathic biotite gneiss; migmatitic in places

Hgr-bg Heterogeneous, medium to coarse grained, granoblastic pink, reddish grey, or buff, well banded biotite granitic gneiss; commonly migmatitic, polydeformed and with amphibolite enclaves

Hgr-ag Heterogeneous, fine to medium grained, salmon to cream, aplitic foliated rock, microgranite, and their gneissic equivalents; commonly migmatitic, polydeformed with mafic enclaves

Hgr-gd Medium grained, grey (black and white), well layered, equigranular, garnetiferous biotite granodiorite gneiss; migmatitic in places

Approximate geological boundary

Approximate limit of continuous overburden

Bedding, inclined 15

Crossbedding, inclined 40

Primary igneous layering, inclined 30

Foliation, gneissosity or banding, inclined, vertical, horizontal, dip unknown 35

Axis of small, ptygmatic folds

Rodding or mullion structure 15

Data station (no structural observation) X

Fault, approximate, displacement unknown

Normal fault, approximate, dot on downthrown side

Thrust fault, approximate, teeth in hangingwall

Zone of pervasive mylonitization, or shearing, or both; inferred or weak where dashed

Kyanite, sillimanite, orthopyroxene Ky, Sil, opx

Lineament or joint, observed or interpreted from air photographs

Radiometric age determination, U-Pb in zircon or K-Ar whole rock: 1 unit Hgd-g, 2 unit Hpxg, 3 Mealy dyke (unit Hod) (see text) 1680 Ma U-Pb zircon

Mineral occurrence: U-uranium, mag-magnetite, il-ilmenite, lab-labradorite XU

Geology of the north side of Lake Melville by P. Erdmer, 1982. Geology of the Mealy Mountains compiled from unpublished data by R.F. Emslie Geological cartography by P. Erdmer

To accompany Paper 84-18

This map may be subject to revision and correction

Base map enlarged from 1:250 000 scale series published by the Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa

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Elevations in feet above mean sea level

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DRIFT

HaPdm

200

DRIFT

Julia Pt

Mulligan Bay

131 △

104 △

Nebavik Pt

Long Island Shoals

Nebavik Shoals

Mulligan Shoal

M E L V I L L E

L A K E

(H A M I L T O N I N L E T)

Long Pt

Hlct

1123±50 Ma
1078±48 Ma
1222±101 Ma
K-Ar whole rock

③

ESKIMO PAPS

X mgr

400

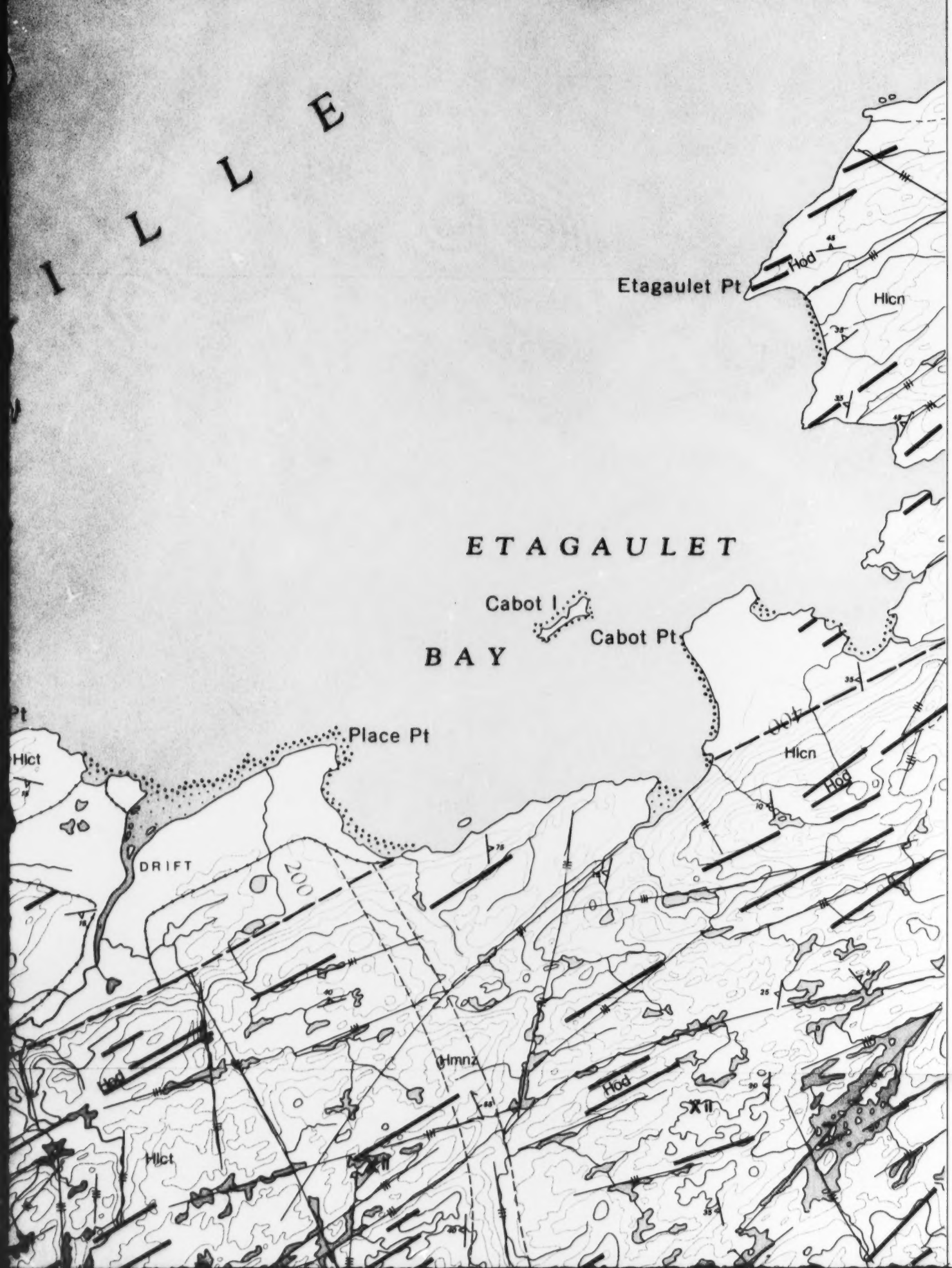
DRIFT

200

674

Hgd

Hlct


I L L E
Etagaulet Pt
Hod
Hlcn
ETAGAULET
Cabot I
Cabot Pt
BAY
Pt
Place Pt
Hlct
DRIFT
200
Hlcn
Hod
Hmnz
Hod
Hod
Hlct

clast-supported conglomerate, pebbly sandstone and minor shale; medium to thick-bedded

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Approximate geological boundary

Approximate limit of continuous overburden

Bedding, inclined — 15

Crossbedding, inclined — 40

Primary igneous layering, inclined — 50

Foliation, gneissossity or banding, inclined, vertical, horizontal, dip unknown — 65

Axis of small, ptygmatic folds

Rodding or mullion structure

Data station (no structural observation) — X

Inferred axis of synform, antiform, showing direction of plunge

Normal fault, approximate, dot on downthrown side

Thrust fault, approximate, teeth in hangingwall

Zone of pervasive mylonitization, or shearing, or both; inferred or weak where dashed

Kyanite, sillimanite, orthopyroxene — Ky, Sil, opx

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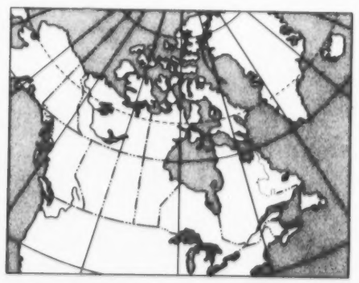
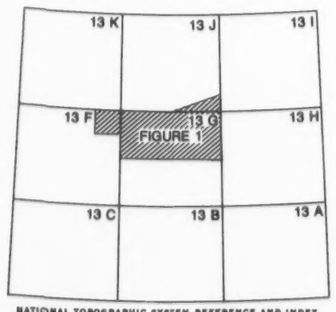


INDEX MAP



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

Scale 1:100 000

Kilometres 2 0 2 4 6 8 Kilometres

Universal Transverse Mercator Projection

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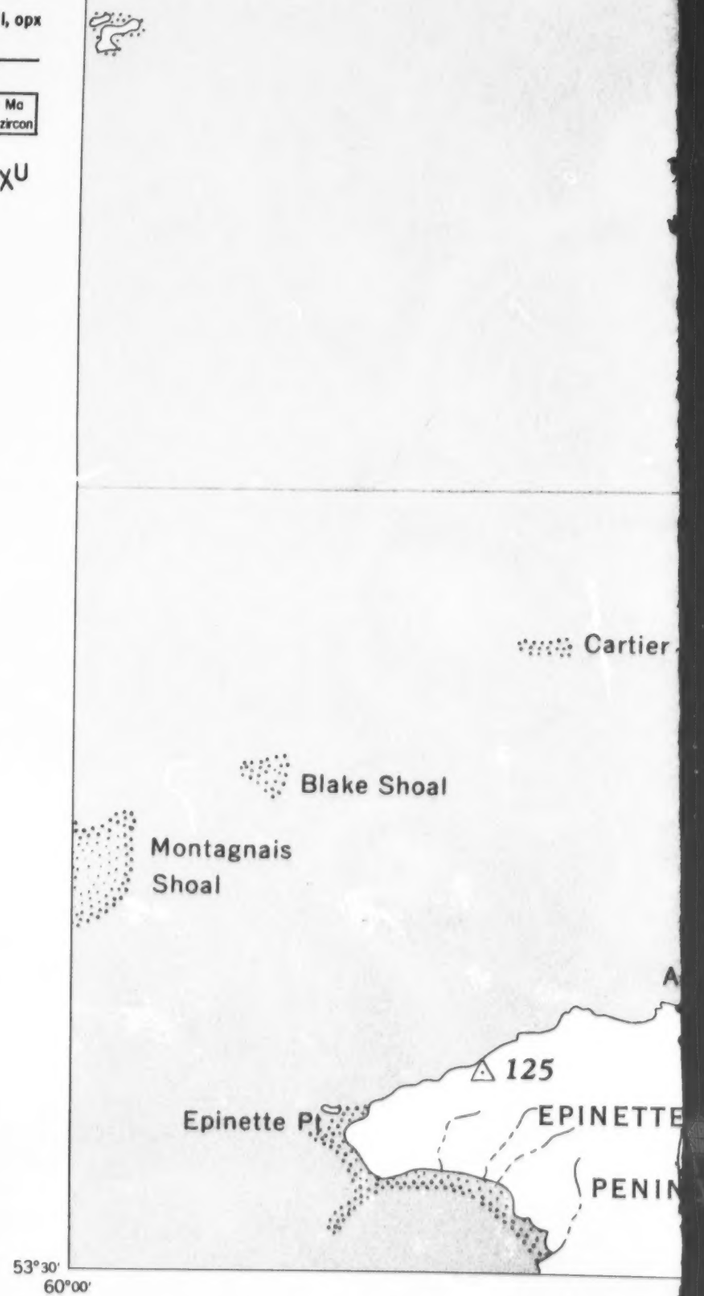

Figure 1. Geo

Figure 1. Geology of the Lake Melville-Double Mer area, Labrador

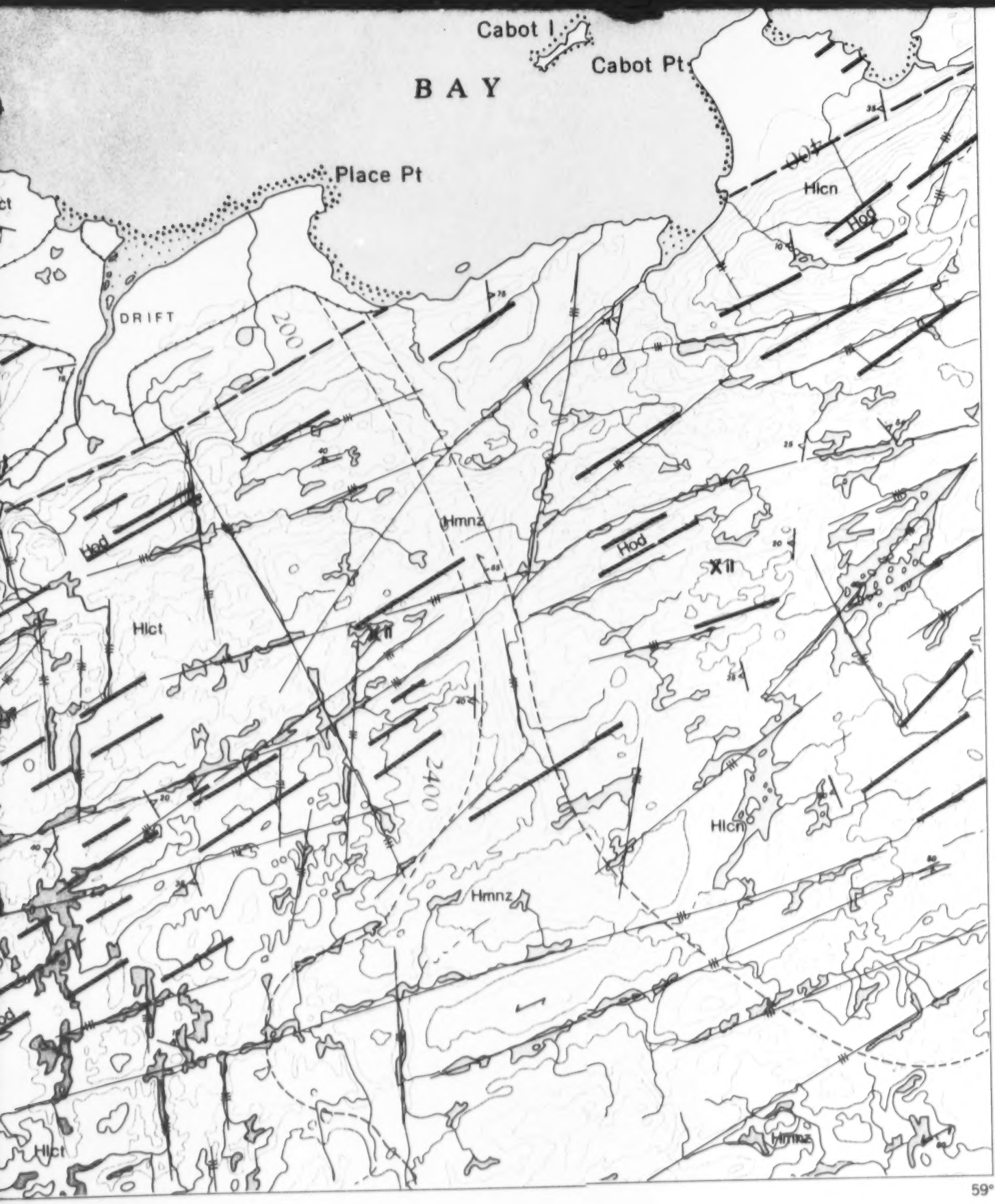

FIGURE 1

GSC Paper 84-18